DURBAN UNIVERSITY OF TECHNOLOGY

DETERMINANTS OF WATER SERVICE DELIVERY CHALLENGES AT THE HARRY GWALA DISTRICT MUNICIPALITY

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Abstract

Water service provision in South Africa is under the jurisdiction of the municipalities. However, most South African municipalities battle various water supply challenges. These challenges have far-reaching consequences on both society and the economy. This study examines the determinants of water service delivery challenges in the Harry Gwala District Municipality. The study adopts a mixed-method approach using quantitative data collected from 412 households and qualitative data collected from 15 employees at the municipality's Water Services Department. The principal component factor technique is used to analyse the quantitative data, while a thematic approach is adopted to analyse the qualitative data. Results from the quantitative and qualitative components of the study are subsequently triangulated. In doing this, the study establishes the key determinants of water service delivery challenges in the municipalities. The main implication of this study is that its results provide a basis for the development of an evidence-based water policymaking in the selected municipality.

Keywords: Water access; water scarcity; water service delivery

Declaration by the student

I, Omega Thuthukile Ngcobo, hereby declare that this dissertation is my original work. It represents my own opinions and not necessarily those of the Durban University of Technology. I also certify that the dissertation has not previously been submitted to any other higher education institution for the purposes of awarding a degree.

Signature:

Dedication

This dissertation is dedicated to my mother, Florina Nokhuthala and my children, Sbongakonke and Ndalwenhle Sithole.

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List of acronyms

CMA	Catchment Management Agencies
CoGTA	Cooperative Governance and Traditional Affairs
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation
IDP	Integrated Development Plan
HGDM	Harry Gwala District Municipality
MFMA	Municipal Finance Management Act
NWA	National Water Act
SAC	South African Constitution
SAHRC	South African Human Rights Commission
Stats SA	Statistics South Africa
UNHRC	United Nations Human Rights Council
UNICEF	United Nations Children Emergence Fund
WHO	World Health Organisation
WSA	Water Services Act
WSAs	Water Services Authorities
WSDP	Water Services Development Plan
WSP	Water Services Providers

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CHAPTER 1

INTRODUCTION

1.1 Introduction and background of the study

The South African Constitution (SAC) of 1996 considers citizens' access to water a fundamental human right. It requires the government to provide an uninterrupted supply of fresh drinking water to all South Africans (Millington and Scheba, 2021). Consequently, the Constitution of the Republic of South Africa (1996) explicitly states that water provision to final users is within the competence of municipalities (also known as water services providers, or WSPs). Nevertheless, despite the promulgation of the Constitution regarding the need for water service providers to provide continuous and uninterrupted supplies of clean water to the people, most municipalities still battle various water supply challenges (Matikinca, Ziervogel, and Enqvist, 2020).

Key water supply challenges experienced are linked to natural water scarcity, climate change, population growth, urbanisation and ageing infrastructure (Leal et al., 2020). It is also essential to note that backlogs due to the segregation policies of the apartheid era created the problem of water supply (Baietti and Curiel, 2017). Despite recording success in water delivery to some areas, South Africa still experiences water delivery challenges in urban and peri-urban areas (Leal et al., 2020). Mnguni (2020) posited that despite the existence of more than 500 government-owned dams, demand in South Africa still outstrips supply. Livingston (2021) argues that addressing water supply challenges requires the involvement of all stakeholders in the water supply chain. Key stakeholders include the three spheres of government: the corporate sector, civic society, and communities.

In pursuit of the water provision mandate, municipalities are guided by several legislations and government policies (Salehi, 2022). Water legislation in South Africa includes the Water Services Act (108 of 1997) and the National Water Act (36 of 1998)

(Carr et al., 2016). The former gives the responsibility of water provision to the municipalities. More precisely, the Water Services Act emphasises water delivery as its core provision. It articulates that access to water services lies with Water Services Authorities (WSAs), which are mostly district municipalities (Oki and Quiocho, 2020). Therefore, it is the responsibility of WSAs through WSPs to ensure that South Africans have access to water services (Oki and Quiocho, 2020). In discharging their duties, both WSAs and WSPs are cognisant of the dictates and guidelines of the Department of Water Affairs (DWA), which plays key roles in policy formulation and regulation.

Roshan and Kumar (2020) argued that South Africa experienced an increase in inequality in water provision and demand. Predictions estimate that by 2030, water demand will be around 17.7 billion cubic metres (Roshan and Kumar, 2020). This is against the existing supply of only 15 billion cubic metres, creating a water deficit of about 2.7 billion cubic metres (Roshan and Kumar, 2020). The emphasis is that the water supply challenge in South Africa is complex due to a wider range of factors, including the reality that the country is naturally a water-scarce country. This is exacerbated by low rainfall, the negative effects of climate change, pollution, low levels of aquifers, and water dependence from nearby countries (Nhamo et al., 2020).

Equally, growth in the country's population, lower-level investments in water infrastructure, and accelerated agricultural and industrial production contribute to the shortage of water (Jachimowski, 2019). In addition to the most visible water challenges, such as water pollution and declining water levels in supplying dams, which can easily be noted in South African municipalities, it is also imperative to point out the common drivers of such challenges. Ziervogel et al. (2022) assert that the common drivers of water service delivery problems in municipalities include insufficient investments in building and developing new sources of water supply, a lack of investments in rehabilitating existing water infrastructure, as well as unfavourable geological and hydrological conditions. Additional drivers include poor maintenance of water infrastructure and a prevalent culture of non-payment among recipients of municipal services (Talanow et al., 2021). This results in poor municipal revenues that eventually affect the municipality's ability to invest more in water provisioning infrastructure (McPhail et al., 2014). However, Semenza and Menne (2014) attribute

the municipalities' lack of performance to limited financing initiatives that support the construction and maintenance of water delivery infrastructure.

1.2 Problem statement

Harry Gwala District Municipality (HGDM) is experiencing various challenges when pursuing its water provision mandate, just like other water-providing municipalities across South Africa. These challenges emanate from several factors in both the micro- and macro-environments. The HGDM consists of four local municipalities, namely, the Ubuhlebezwe local municipality, Dr Nkosazane Dlamini Zuma local municipality, the Greater Kokstad local municipality and the Umzimkhulu local municipality. Generally, water demand in the district far exceeds supply (Harry Gwala Water Department Director`s Annual Report, 2021). The District Municipality persistently fails to provide clean and quality water to all the residents in the four municipalities (Harry Gwala District Municipality Annual Mayoral Report, 2021). This confirms Verlicchi and Grillini's (2020) assertion that the provision of low-quality water services poses a danger to both the health and living standards of residents.

The importance of sustainable water management is clearly emphasised in the Sustainable Development Goal (SDG 6), which targets the availability and sustainable management of water and sanitation for all (Hák, Janoušková, and Moldan, 2016). Despite democratic national government and HGDM efforts to ensure sustainable water management, there are regular outbreaks of water service delivery protests expressing dissatisfaction with the failure to provide clean drinking water to residents. For instance, residents of the communities of KwaNokweja and eMazabekweni in the uBuhlebezwe Local Municipality protested severe water shortages in July 2018 (Harry Gwala Mayor`s Annual Report, 2018). In March 2019, service delivery protests also erupted in the uMzimkhulu Local Municipality, whereby residents were complaining about the shortage of water, among other things (Public Works and Human Settlement, 2019).

Additionally, the HGDM has consistently failed to provide the regional bulk water supply scheme for the Kokstad Local Municipality through reviving the Riverside, Shayamoya and Bhongweni emergency water intervention schemes as well as the six

(6) springs in Springvale (Harry Gwala District Municipality Annual Report, 2018). Further, water schemes' refurbishments are not operating as per expectations in uMzimkhulu Local Municipality. In another example, planned water supply intervention schemes by the District Municipality in the uMzimkhulu Local Municipality have not yielded any positive results, and progress has been slow since 2012 (Harry Gwala District Municipality Annual Report, 2018). Equally, progress towards providing clean water in the Dr Nkosazana Dlamini Zuma Local Municipality (NDZLM) through the drilling of boreholes, the construction of a pipeline, raw water plant upgrades, and the repair of vandalised reservoirs and pipelines has been very slow (NDZLM Report, 2017). These water challenges in HGDM require an exploration on the main drivers of water service delivery challenges.

1.3 Aim and objectives of the study

The aim of this study is to explore the determinants of water service delivery challenges in the HGDM. This aim is achieved through the fulfilment of the following three objectives:

i. To identify the water service provision challenges experienced at the Harry Gwala District Municipality,

ii. To identify the main drivers of the water services provision challenges at the Harry Gwala District Municipality, and

iii. To recommend possible solutions to address water services challenges at the Harry Gwala District Municipality.

1.4 Significance of the study

The determination of water supply challenges experienced by HGDM requires the identification of strategies to solve these challenges. This helps in improving people's standard of living through the provision of clean and sufficient water services (El Batouti, Al-Harby, and Elewa, 2021). Therefore, findings from the study will be useful

to the management of the HGDM as they highlight areas where management should focus their attention to improve both managerial effectiveness and water service delivery. Subsequently, improvements in water service delivery will benefit residents in terms of satisfaction, improved health, and better living standards.

The study could potentially make valuable contributions to the academic literature on water service challenges. It is envisaged that the study's findings will contribute to the existing body of academic knowledge regarding the determinants of water service delivery challenges. Current literature on South African water service delivery challenges primarily addresses the types of challenges communities experience and their underlying causes (Harris, 2020). Other scholarly work explores and predicts imminent water challenges for South African communities (Patrick, 2021). However, analysis of the literature indicates a gap in studies that explicitly describe drivers of water challenges in municipalities. The existing literature provides national perspectives, while others are outdated as water challenges are consistently changing (Zuma-Netshiukhwi, Stigter, and Walker, 2013; Ziervogel et al., 2010). This study identifies the drivers of water service provision challenges from local perspectives.

1.5 Organisation of the study

The study is organised into six chapters. Chapter 1 introduced the study. It contextualised the study by discussing the study background, problem statement, study significance, and layout of the study. Chapter 2 provides a review of the theoretical and empirical literature on the determinants of water service delivery challenges. Chapter 3 discusses the methodology used in the study. Chapter 4 discusses findings of the survey, which was conducted among households sampled across the HGDM. Chapter 5 discusses findings from interviews conducted with employees at the Water Services Department of the HGDM. Chapter 6 concludes the study by triangulating results from households and municipal employees and providing recommendations as well as the limitations of the study and areas for future research.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

There is a growing interest in investigating water provision challenges and their causes in the literature. This interest is observed more in developing countries, which mostly experience a plethora of challenges in water service provision. The challenges are commonly due to backlogs and insufficient financial resources to build the necessary infrastructure to meet the rising water demand. This chapter discusses some of the literature on the determinants of municipal water provision challenges. The chapter is organised into five sections. First, the chapter discusses some of the relevant literature on municipal water service provision and the theories that underpin water service provision. Second, the chapter discusses the structure of the South African water sector. Third, the chapter delves into the key South African legislation that govern water service provision. Fourth, South African water-related policies, determinants and common drivers of the water service provision challenges are discussed. Finally, a discussion of some solutions to water service challenges in the literature and a conclusion are presented.

2.2 Theoretical literature

Literature contains several theories that explain the provision of the public sector water services. The most notable theories include the open system theory for water management (Ashby, 1964), the water supply reliability theory (Shamir and Howard, 1991), and the differential tax theory (Mirlees, 1972; Tsyvinski and Werquin, 2017). While many other theories do exist, these three underpin the context of this study. Therefore, this section presents a detailed discussion of the three selected theories and how they apply to the study.

2.2.1 The open systems theory for water management

The theory has its origins in the work of von Bertalanffy in the 1940s, who was more inclined to the interdependence between inputs and outputs in the ecological environment. The original version of the theory advances the idea that organisations are made up of several sub-units and actors who are involved in several different interdependent roles and processes necessary for achieving organisational goals. Ashby (1964), Forrester (1970) and Saravanan (2008) separately made further modifications to the theory. These modifications made the theory more applicable to a wide variety of disciplines. Nevertheless, the modified versions still explain the interactive nature of various actors in water management.

Modifications by Saravanan (2008) improved the theory into a more useful model that explains the complexities in water management. Thus, the modified model is known as “a systems theory framework for water management.” According to the theory, bio-physical resources like the climate, geological, and situational factors in the micro- and macro-environments act as inputs utilised by various agents to produce outcomes such as water services. Favourable climatic conditions provide a favourable contextual environment for water production. Such factors are contextual and can be negative or positive. The occurrence of droughts and natural disasters that cause complexities in water provision is an example of a negative contextual factor. Figure 2.1 illustrates the water management integration framework explained in the theory.

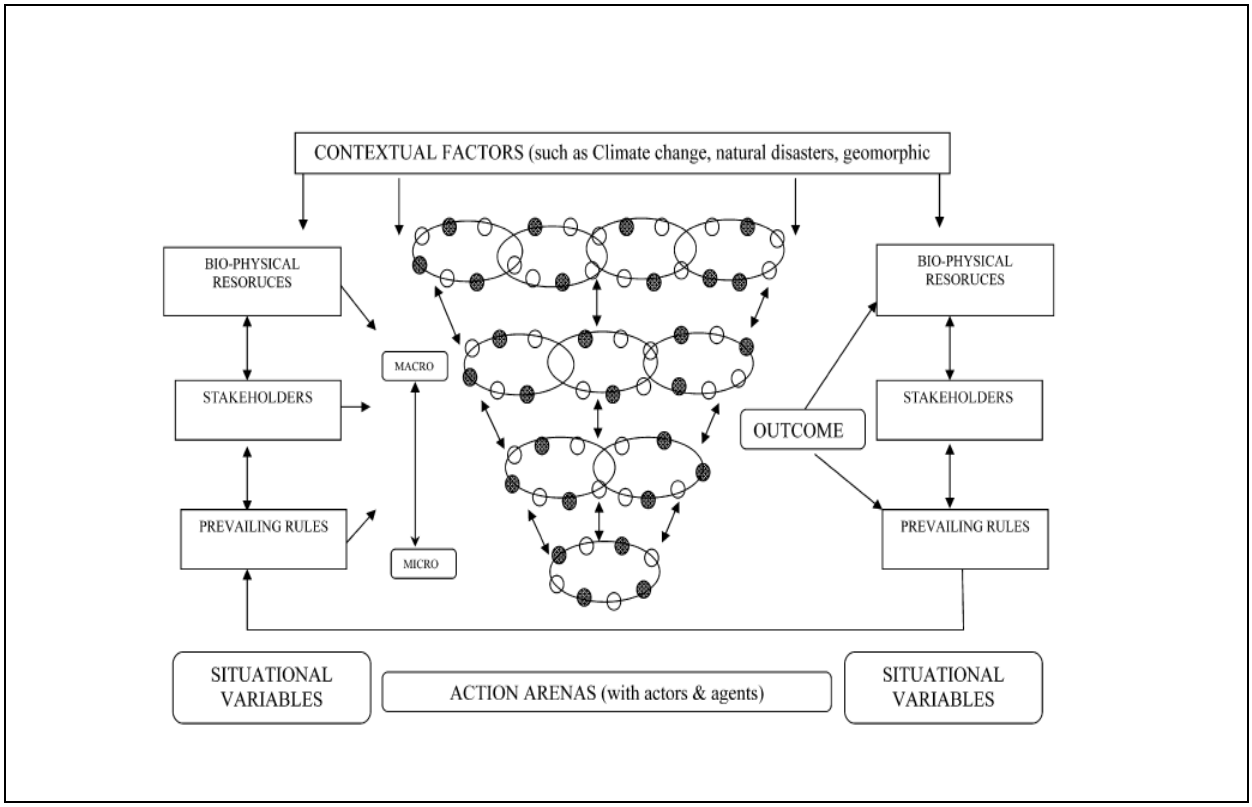

Figure 2.1: The framework for analysing water management integration

Source: Saravanan (2008)

The water management integration framework depicted in Figure 2.1 illustrates the factors to consider in the management of water resources. In coordinating the management of water resources, water service providers need to acknowledge the effects of contextual factors such as climate change and natural disasters. Additionally, the importance of stakeholders' participation in formulating rules that govern the utilisation of biophysical resources is also emphasised. The diagram further recognises the differences that are inherent in water resources management by integrating situational factors into water resources management. In this regard, water service providers need to take into consideration the situational factors relevant for effective water service provision.

The implication of the systems theory framework for water management is that a failure in any single component of the water supply system can render the entire system dysfunctional. As a result, the water service provider fails to achieve its intended water supply objectives. To avoid disruptions, water supply should be institutionalised before building up effective coordination systems (Saravanan, 2008).

This is plausible given that water supply by an organisation enables the effective coordination of all the interacting stakeholders to ensure the fulfilment of all specified objectives.

The systems theory is praised for its recognition of the existence of several inputs (stakeholders, actors, bio-physical resources, and rules), which are crucial components of water management in the practical world (Ameyaw and Chan, 2015). In the context of this study, the assumptions that underline the theory are closely linked to the South African water distribution sector, where only municipalities are authorised to distribute water as a measure to promote consistency and social welfare. The theory emphasises that an effective water management system involves various stakeholders, such as policymakers, managers, consumers and other groups that are directly involved in water affairs. It is also evident that water delivery in South Africa is institutionalised with various stakeholders, who range from policymakers in the Department of Water and Sanitation (DWS), to those at the municipal level, consumers and other stakeholders playing key roles in the management of water affairs.

Furthermore, the theoretical concept of an open system of water management has relevance in the practical world and to this study for two main reasons. Firstly, several empirical studies in the literature attest to the effectiveness of institutional rules and the proper coordination of stakeholders and actors in water management. For instance, water management in countries like the United States, the United Kingdom and South Africa is run by organisations that coordinate water provision (Boccaletti, 2015; Nakagawa, 2020), hence confirming the practical validity of the theory. Secondly, most water management frameworks incorporate the principles of open water management systems. This is demonstrated by the appointment of several public officials (who become actors) and the creation of organisations responsible for water management and coordination (Muller, 2017). However, one of the main limitations of the theory is the assumption that all actors and stakeholders act with a common purpose. Reality has shown that most actors have diverse perspectives and interests, which often go against the goal of achieving equal access to quality water services.

2.2.2 The water supply reliability theory

The study adopted the water supply reliability theory spearheaded by Shamir and Howard (1991) and modified by D'Ercole et al. (2017). The theory identified reliability in the water supply system as a major determinant of water supply. If the major components of a water supply system are reliable and not susceptible to frequent breakdowns, the water supply would be reliable and would not pose a challenge to water service providers and consumers. Faults in mechanical components, water mains, or electrical components inadvertently affect the reliability of the water supply. All the components in the water supply system have an interdependent and indispensable role in water supply reliability. As a result, the most important determinant of water supply reliability is the optimal design and operation of water distribution systems. Successive failures in the components of a water distribution system may lead to a less reliable water supply, while timely and efficient interventions for component breakdowns improve supply reliability.

The theory is relevant to the practical world as it sheds light on the reality that a water supply system consists of integrated components, all of which must operate more efficiently to ensure a reliable and efficient water supply. A lack of reliability in the system negatively impacts the water supply system and might cause water shortages (Delcore, 2017). One of the theory's criticisms is its assumption that the demand for water in an economy is always known, allowing for supply adjustments to meet this known demand. This assumption is a bit further from the truth because, in practice, it is complex to predetermine water demand accurately and sufficiently in an economy, as the daily usage usually varies over time and has a random seasonal component (Delcore, 2017). Thus, adding water demand variability and seasonal factors affecting water demand is more practical and convincing (Damelin, Shamir and Arad, 2014; Delcore, 2017). Modifications to water supply reliability theory by Delcore (2017) state that increasing the production capacity of sources of water supply, standby pumping capacity at sources, increasing the conveyance capacity of pumping transmission lines, additional pumping pipelines, and improving the maintenance of pumping and pipes.

These modifications allow for the possibility that water supply reliability can still be achieved even if there are breakdowns in major components. Thus, the modified version of the theory can be vital in explaining dynamics in the water distribution sector. In this study, the water supply reliability theory is more relevant because it clearly identifies the most critical determinants of water supply reliability. The theory convincingly explains that if the components of a water supply system are not reliable, it often leads to water supply shortages and many other challenges. The theoretical ideas expressed in the theory are practically useful and instructive in terms of providing long-lasting solutions to water supply challenges. Therefore, governments and water supply utilities should invest in water production and supply capacity by building more water reservoirs, performing robust water engineering and maintaining the water infrastructure (United Nations, 2018).

2.2.3 The differential tax theory

The differential tax theory was established by Mirlees (1972) and expanded on Tsyvinski and Werquin (2017). It emphasises that a tax system aims to attain optimality through by improving social welfare. The constraints emerge as some property owners in a municipality are unable to pay the same rate of property tax as others in the same municipality. The theory mandates the social planner to rationalise taxation based on the principle of ability to pay. This implies that income levels are a central factor in taxation. In extending the theory, Tsyvinski and Werquin (2017) rejected a flat tax rate as an unfair approach to low-income families and marginalised people. Most importantly, a flat tax rate has a limited impact on the wealthiest people. Equally so, increased levels of tax rates might force impoverished people to revolt against fulfilling tax requirements. Kazman (2014) concurred with the theoretical proposition by Tsyvinski and Werquin (2017) and argued that a higher tax rate would disincentivise the poor to pay, leading to defiance and unwillingness to pay. Defiant behaviour among ratepayers can eventually result in resistance and service delivery protests (Kazman, 2014). Thus, although an increased flat tax rate generates more revenue for water provision utilities, it also has a negative effect on low-income families.

The differential tax theory was relevant to this study because it takes into consideration the determinants of the challenge of low revenue collections due to non-payment of rates that are currently experienced across South African municipalities. Municipalities that provide water services in South Africa struggle to collect enough revenue for re-investment in water infrastructure. Ideally, residents are reluctant to pay water rates because they are poor and perceive the rates to be high (Miguel, 2014). The differential tax theory gives reasons for non-payment and offers some useful insights regarding the taxation of different socio-economic categories of ratepayers in each municipality. It advocates that it would be prudent for well-to-do income residential areas to pay higher water rates. Equally, the middle-income residential areas may be placed at a lower rate than the high-income areas, with low-income areas paying less than the two residential areas.

The loophole of the theory is that taxing the rich at higher rates for water consumption can be detrimental to the municipality because it may persuade the wealthy to evade paying municipal water rates by using either legitimate or illegitimate means (Miguel, 2014). For instance, if the rich get to know that they are being unjustly made to pay more, they may either fund the drilling of boreholes in their respective residential areas and get disconnected from municipal supply or even invest in water-efficient technologies to minimise their consumption of municipal water. If more rich people resort to these practices, municipalities will lose revenue. Additionally, taxing the rich and middle-income people has a limited impact as they constitute a smaller percentage of society (Burger, 2015). Booysens (2014) questions the reasoning behind the differential tax theory after analysing more than 1600 rate-paying households and finding that the root of non-payment lies within the “willingness to pay” as opposed to “affordability and income.” Booysens (2014) shows that a significant number of poor households paid for municipal services. Equally, Schoeman (2013) criticised the theory for being unconstitutional and against the ethical principles of fairness and natural justice, as it seeks to make certain people pay more for the same services in a democracy. Importantly, heavy taxation of rich people discourages hard work and investment, which affects revenue collection from other sectors (Schoeman, 2013).

Notwithstanding the stated weaknesses, the validity of the differential tax theory is supported by empirical evidence demonstrating that individuals with lower socioeconomic status prioritise essential needs for sustenance above other expenditures. Moreover, the theory's operational validity is evident globally, with most municipalities in developing nations implementing varying prices for water and sanitation, property, and power, depending on the income levels of residential regions. Thus, in the context of water provision by South African municipalities, the theory is more aligned with the cross-subsidisation of water services adopted in the country through the increasing block tariff (IBT) pricing structure commonly used across municipalities. Equally, policies like free basic water (2002), where the indigent receive free basic water services, show a practical application of the differential tax theory in South Africa.

2.3 Empirical literature

A plethora of studies on municipal service delivery exist in the literature. The emphasis of the studies is on service delivery as an inclusive phenomenon. Some of the studies look at different aspects of municipal services, such as water, electricity, sanitation, and solid waste collection, among others. There is a growing body of literature on studies that examine public water service delivery issues. This section presents a discussion of some of the existing empirical literature regarding challenges in water service provision. The section is organised into five main subsections. First, a discussion of key players and their roles in the South African water distribution sector is presented. Second, the legislation governing the South African water distribution sector is discussed. Third, this section discusses the water-related policies in South Africa. The fourth section discusses the common challenges and their drivers in the South African water sector. The final section discusses some of the literature on solutions to water service provision challenges in South Africa.

2.3.1 International perspective on water service delivery

Water service delivery is a critical component of the sustainable development framework, primarily Goal 6, which emphasises the provision of clean water and sanitation. The SDGs are a universal call to action aimed at ending poverty, protecting the planet, and fostering peace and prosperity (Sachs et al., 2019). SDG 6 emphasises the importance of integrated water resources management through promoting combined development, water management, land use, and maximising economic welfare for all (Hák, Janoušková, and Moldan, 2016). It values sanitation by prioritising access to adequate hygienic conditions. What is interesting about SDG 6 is that it sets targets that should be attained by 2030. The targets include achieving safe and affordable drinking water, fostering access to sanitation and hygiene, enhancing water quality, facilitating safe reuse, as well as increasing water-use efficiency (Le Blanc, 2015).

More importantly, SDG 6 aims to facilitate the implementation of integrated water resources management and safeguard water-related ecosystems (Le Blanc, 2015). This explains a global framework underpinned by the desire to ensure access to clean and safe drinking water for all. In Kenya, water service delivery is managed through the Water Act of 2002, while the Ministry of Water and Irrigation (MWI) spearheads policy formulation, resource mobilisation, and planning (Chepyegon and Kamiya, 2018). MWI is decentralised into regional and local institutions, which operate at the level of autonomy. Koehler (2018) recognised the water sector management in Kenya as critical in cutting down bureaucracy, which enhances the efficiency of water service delivery. While the structural and policy framework has been demonstrated to be sound, Hanjahanja and Omuto (2018) observed that the operation and maintenance process creates challenges in water service delivery because of poor management practices.

This is evident in urban areas where the majority of water delivery is limited, while in rural areas, water supply is lower than 25% (Chepyegon and Kamiya, 2018). Consistent with this perspective, Bellaubi and Visscher (2014) indicated that the lack of technical standards in water service delivery creates gaps in national, regional, and local water service delivery. Despite other scholars' perspectives on challenges of water service delivery, Koehler (2018) blamed a shortfall in funding as the department

receives approximately 2.8% of the national budget. Zimbabwe, as a semi-arid landlocked country in Southern Africa, experiences limited water resources and lower rainfall (Matamanda and Chinozvina, 2020). The country receives an average of 657 mm of rainfall, while water availability per capita is lower than 1700 m3/year (Chirisa and Bandauko 2015). This explains Zimbabwe as experiencing sequential droughts that increase water demand on limited resources. Tom and Munemo (2015) acknowledged that water service delivery in Zimbabwe is below standard because of institutional and policy reforms that failed to respond to infrastructural needs.

Such failures manifest through waterborne disease outbreaks such as cholera and typhoid. Despite the adoption of the National Water Policy in 2013 to address water delivery infrastructure dilapidation, water availability, equity access, and enhanced customer services remain present (Reniko and Kolawole, 2020). More importantly, water service delivery in Zimbabwe is constrained by political exclusion, violation of human rights and state-led displacement, such as the infamous “Operation Murambatsvina” of 2005 (Matamanda and Chinozvina, 2020).

2.3.2 The South African water distribution sector

The South African water distribution sector is structured in a way that allows for the coordination of water resources, starting from the national level, through the regional level, and down to the local level (Nhemachena et al., 2020). This structure is designed to allow for the implementation of a decentralised and participatory approach to water management to increase water usage efficiency. The structure of the South African water distribution sector is a result of the reorganisation of water management bodies (Dube, Nhamo, and Chikodzi, 2022). Key players in the management of the South African water distribution sector are the Department of Water and Sanitation (DWS), Catchment Management Agencies (CMAs), Water Boards (WBs), Water Services Authorities (WSAs), Water Services Providers (WSPs), and consumers. These key players are interlinked and play significant and distinctive roles in the water distribution sector.

The DWS is a governmental ministry tasked with the primary role of developing and executing policies pertaining to water (Nhamo et al., 2020). The statutory mission is to

safeguard, oversee, use, advance, preserve, and regulate South Africa's water resources in a way that is advantageous to all people and the environment (Adeleke et al., 2020). DWS functions as a regulatory body in the water industry, establishing national standards and regulations for water services, as well as overseeing and assisting other entities involved in water distribution. Its regulatory function involves assisting organisations in adhering to current rules and implementing institutional changes. It also involves enforcing established standards by providing incentives for excellent performance and imposing penalties for non-performance (Murwirapachena, Dikgang and Mulwa, 2024).

CMAs are water management governance bodies that are representative of all sections of the population, including previously disadvantaged population groups. Their main responsibility is to administer water resources at the regional or catchment level (Paterson, 2022). As a result, they are obliged to engage local communities within the structure of their general water resource scheme for water management and allocation. This implies that, in addition to managing the national water resources across its various uses and water management organisations, CMAs are charged with the responsibility to encourage community involvement in water management. This ensures that there is equity in water distribution and consumption by all people in the CMAs' communities, as required by the Constitution. To effectively execute their roles, CMAs should craft a catchment management strategy founded on an assessment of accessible quantities of water and water allocation plans in the relevant catchment (Department of Water Affairs and Forestry, or DWAF, 2021). The Department of Water Affairs (DWA, 2020) mandates WBs to manage regional water resources, including bulk portable water and wastewater infrastructure. To effectively execute their mandate, WBs have regional water and sanitation forums, which act as locally restricted catchment management forums meant to provide additional room for civic participation in water governance (Environmental Monitoring Group, 2016).

WSAs are municipalities that are constitutionally mandated to provide potable water and sanitation services (Scheba, 2022). The WSAs can directly provide water services to consumers. This is the reason they are called water service providers (WSPs). In some cases, WSAs outsource the water services provision function to other municipalities or WBs to provide water services on their behalf (Buthelezi, 2022). This

is permitted by South African laws, and when that happens, the outsourced part becomes the WSP. This is usually the case in district municipalities with secondary cities where the district is the authorised WSA but delegates the water services provision function to the secondary city (category B1 local municipality). Nevertheless, the WSA will remain responsible for operating, maintaining and managing the water infrastructure. They are also responsible for putting in place an appropriate water tariff structure that is capable of recuperating operational and maintenance costs and encouraging efficient water usage (Buthelezi, 2022). WSPs are organisations that provide water services to consumers. These can be municipalities, WBs, or even private organisations authorised by a WSA to provide water services to consumers within its jurisdiction on behalf of the WSA (Rivett et al., 2015). Generally, the WSA appoints WSPs to carry out water provisioning services when the municipality for a particular area is not able to provide such services or the delivery of such services by the municipality is unreliable.

Water consumers are also key players in the water distribution sector. These are classified into agricultural, municipal (urban and rural), industrial, afforestation, power generation, mining, livestock watering and nature conservation consumers. Agriculture is generally the largest consumer of water resources at 61%, followed by municipalities at 27%, power generation at 2%, and mining at 2%, among others (Viljoen, 2019). Agricultural consumption, which is mostly unmetered, is a source of concern because of the unauthorised abstraction and water wastage by some of the consumers and the payment of relatively lower tariffs by others for untreated water, which does not incentivise the adoption of efficient irrigation methods (DWA, 2020). Municipal water use in the country is estimated to average about 237 litres per individual daily and is relatively high when compared with the world average of about 173 litres per individual daily (Viljoen, 2019). Literature blames excessive water usage by municipalities on non-revenue water, which constitutes approximately 41% of the water consumed in the country. Nevertheless, it indicates that water consumption varies from one municipality to another (Rivett et al., 2015).

The relationship between the different stakeholders in the South African water distribution sector is both direct and indirect. Direct linkages between these players are explained through the way they relate to each other in the water services value

chain (Buthelezi, 2022). On the other hand, indirect linkages may exist through spatial development initiatives, economic development strategies, and environmental implementation plans prepared by municipalities to tackle water infrastructure, environmental management, and water allocation (Rivett et al., 2015). Figure 2.2 shows the linkage between stakeholders in the South African water sector (i.e., the water sector value chain).

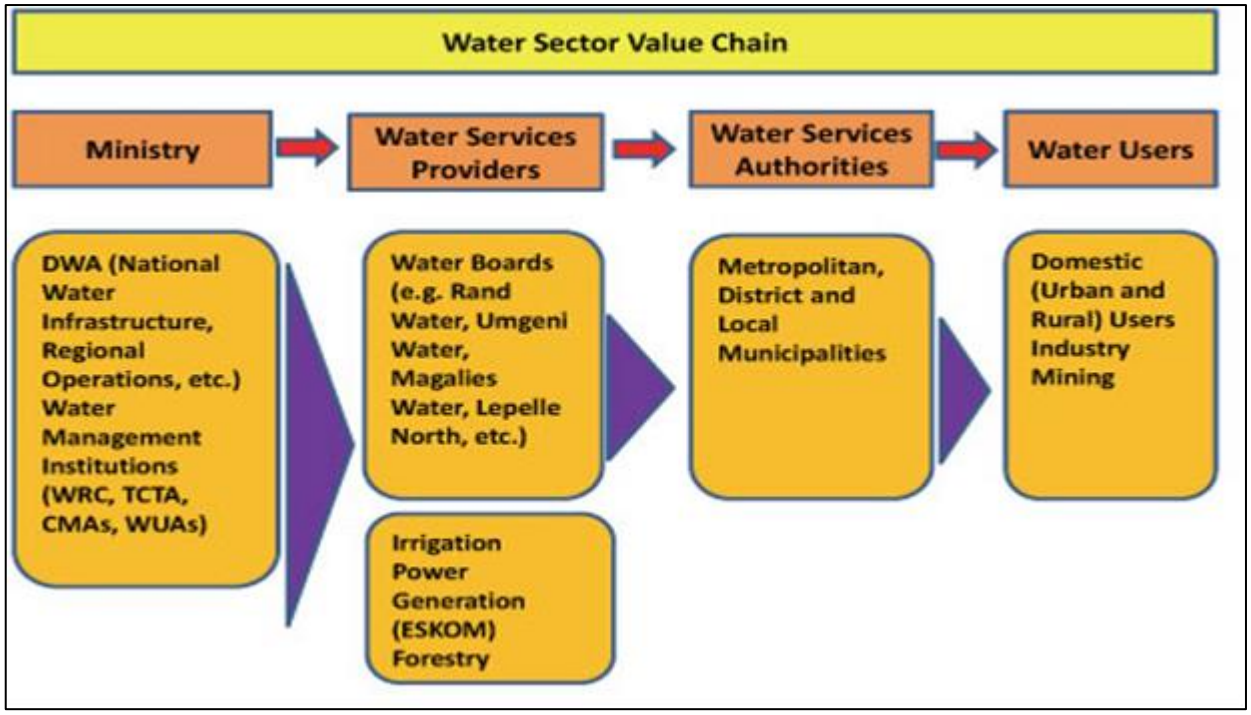

Figure 2.2: The water sector value chain in South Africa

Source: Ruiters (2013)

Figure 2.2 illustrates South Africa's water supply value chain and how stakeholders in the South African water distribution sector relate to one another. The Ministry in this context refers to DWS (formerly known as the Department of Water Affairs, or DWA). The role of the DWS was explained earlier in this section. However, it is imperative to emphasise that the DWS is at the centre of water policymaking and plays the role of a regulator in the water sector. WSAs and WSPs take guidance from the DWS in providing water services to final consumers, who are both domestic and non-domestic.

2.3.3 Legislation governing the South African water sector

The Constitution of the Republic of South Africa (1996) identifies access to water through the lens of human rights. The government, its departments, and associated agents have a responsibility to provide potable water to all South Africans. According to the Constitution of South Africa (1996), it is illegal and an infringement of human rights to offer water that is polluted and not suitable for drinking. Thus, it is incumbent upon towns to undertake every step required and adhere to both international and national standards for water quality. Various acts were enacted to complement the Constitution and provide adequate guidance in the provision of water services. These include the Water Services Act (108 of 1997), the National Water Act (36 of 1998), the Municipal Systems Act (32 of 2000), and the Municipal Finance Management Act (56 of 2003).

The Municipal Systems Act (32 of 2000) establishes standards that empower municipalities to improve communities by guaranteeing access to vital services. According to the Act, the Council is required to establish and enforce a tariff policy that imposes charges for the municipal services provided. Therefore, the Act grants towns the authority to impose rates as a means of producing their own money. Moreover, it defines the legal essence of a municipality as encompassing the community and elucidates the administrative and legislative authorities of municipalities. The primary objective of the Act is to enhance the efficiency of local government by creating a structure for municipal planning, performance management and optimal resource utilisation. Additionally, it guarantees that towns establish service prices and credit control regulations that acknowledge the requirements of the impoverished and encourage the involvement of local communities in government. For this research, it is crucial to comprehend the rules outlined in the Municipal Systems Act to effectively comprehend and tackle the present issues faced by South African towns in providing water services.

The Water Services Act (108 of 1997) is the main legislative document that governs the access to and supply of water services. It establishes a system for organising and providing water services. The legislation acknowledges the entitlement to get essential water services that are crucial for ensuring an adequate water supply and a healthy environment that does not pose any risks to public health or community welfare. The

obligation to provide water is delegated to municipalities. A municipality that has been granted the power to provide water services is referred to as a WSA (Water Service Authority). If the WSA provides water services directly to the public, it transforms into a WSP. The legislation permits a Water and Sanitation Authority (WSA) to designate other municipalities, water boards, or private entities to serve as Water and Sanitation Providers (WSPs) on its behalf. As per the Act, it is mandatory for all water services organisations (WSAs and WSPs) to make reasonable efforts to ensure that every person has the fundamental right to obtain water services. Water services may only be given in accordance with the legal requirements for public access and compliance with the legislation of each municipality. Within the scope of this research, the Act serves as a framework for facilitating conversations on the legal responsibilities and requirements of municipalities acting as Water and Sewer Authorities (WSAs) and Water and Sewer Providers (WSPs).

The National Water Act (36 of 1998) was designed to adhere to constitutional requirements for managing water quality. The Department of Water and Sanitation (DWS) serves as the regulatory body for the water industry and is responsible for administering the National Water Act. Every municipality classified as a Water Service Provider (WSP) must ensure the provision of clean, hygienic, and properly treated water. Additionally, they are obligated to manage water resources in a fair, balanced, and comprehensive way. The Act highlights the need for municipalities to fulfil their water supply responsibilities in a way that encourages effective management of water resources to guarantee suitability for use. Within the scope of this research, the National Water Act primarily promotes comprehension of the legal responsibilities and directives that towns must adhere to in order to provide high-quality water services.

The Municipal Finance Management Act (MFMA) 56 of 2003 modernises the budget and financial management practices by making municipal finances more sustainable. It gives municipalities the capacity to maximise revenue and efficiently deliver public services. Essentially, it is read together with Section 3(1) of the Municipal Property Rates Act (MPRA) 6 of 2004), which requires each municipality to design and implement a rate policy subject to consultation with community members. MFMA requires municipalities to set service tariffs in line with the socio-political and economic environment in which they operate. Municipalities should engage key stakeholders

and set tariffs that are higher than cost for financial viability. More importantly, the MFMA prescribes accounting, financial management and financial reporting guidelines for the use and application of municipal funds. This Act has greater relevance to the study, as it offers valuable insights into the application, accounting, and management of water rates and other water infrastructure development funds that ought to be applied, accounted for, and managed to ensure sustainability in the provision of water services.

The Environment Conservation Act (73 of 1989) is another key piece of legislation in the South African water sector. Modified in 2003, the Act obligates municipalities to oversee water quality in a holistic manner while acknowledging that there is a link between all elements of the environment. It prescribes that water quality oversight includes conservation of the environment. Therefore, authorities and key stakeholders must ensure the adoption of quality water using the most practical options to minimise the adverse impacts on the environment. Managers in the water sector are expected to apply a precautionary strategy when overseeing quality water. Since one of the objectives of the study is to recommend strategies that address the challenges faced by municipalities in water service provision, this Act is useful to the study because it provides guidance on environmental law enforcement and proper environmental management.

In summary, the Constitution (1996) recognises water as a basic human right, compelling WSPs to guarantee people's access to clean water. In tandem with the Constitution, the Municipal Systems Act 32 of 2000 provides guidelines imperative for improving the welfare of people by their local authorities. This guideline includes the collection of levies from those who receive water services. Additionally, the Water Services Act 108 of 1997 provides an institutional framework for the delivery of water services and recognises people’s right to access basic water services. Apart from these provisions, the National Water Act 36 of 1998 mandates that WSPs provide clean, hygienic and appropriately treated water, while also managing water resources judiciously. Conversely, the MFMA, which is read together with Section 3(1) of the MPRA, empowers municipalities to maximise revenue and efficiently deliver public services.

2.3.4 Common policies in the South African water distribution sector

Various national policies guide municipalities in water delivery services. Government policies, by their very nature, are rules or principles that guide decisions to effect positive outcomes that enhance communities. They provide the rationale behind the execution of specific activities. In South Africa, the government has several policies that aim to, inter alia, address poverty and inequalities, promote public participation in municipal affairs, and enable municipalities to sufficiently raise revenue from public services. Some of the most common policies in the South African context include the Indigent Policy, the Integrated Development Plan (IDP) Policy and the Debt Collection Policy.

The Indigent Policy (IP), adopted in 2001, guarantees that poor households and vulnerable community members receive free basic water services. In general, the indigent water policy stipulates that an indigent household is entitled to 6 000 litres of free and safe water per month. The 6 000 litres per month are expected to be sufficient to promote healthy living for a family of eight. This stipulation is consistent with international practices and norms that recommend 25 litres per person per day. Each municipality should identify indigent households that would receive free basic services within its jurisdiction. Many families across South Africa are recipients of free basic services. For example, in 2017, there were 3.51 million indigent households across South Africa, indicating that 1 in every 5 of the country's 16.2 million households was indigent (Statistics South Africa, 2019a). The indigent policy is useful to this study because of the role it plays in influencing decision-making in relation to the management of water resources.

Another crucial policy governing water provision by municipalities is the IDP. It aims to promote community-based planning for developmental projects. When used in planning for future development, the IDP provides municipalities with a way of circumventing poor planning, which is associated with underdeveloped and overly subserviced municipal areas (IDP, 2006). The IDP policy compels municipalities to involve communities within their jurisdictions when developing long-term development solutions. It provides a general guideline for growth by enabling the holistic coordination of a municipality's work in a manner that enhances the quality of life of all residents in the municipality. The policy considers both the cost-effectiveness and

collective improvement of an entire municipal area when developing a framework for water infrastructure requirements and environmental protection.

The Debt Collection Policy makes available a structure within which a municipality can practice its administrative and legislative powers in relation to managing debts owed to it by its residents. Thus, the policy was used to establish a municipal credit strategy that is aligned with the national credit policy framework. This strategy guarantees that debts payable to the municipality are collected in an economic and sustainable manner. Additionally, the policy encourages municipalities to specify the permissible duration for an outstanding debt owed to them and to arrange for customer support. For instance, the policy allows municipalities to implement 30-day debtor collection cycles, subject to interest charged at prescribed, variable rates on overdue water accounts. The policy allows municipalities to craft debtor collection bylaws that stipulate the circumstances under which legal action can be instituted against defaulting debtors. Thus, the policy guides municipalities on debt collection and credit control by prescribing possible actions that a municipality may institute to safeguard payments that are outstanding. Such actions may include the cessation or restraint of services, as well as legal actions.

The above discussion highlights that national policies are sources of guidance in decision-making processes that significantly impact people's lives. A notable example is the Indigent Policy, which provides a framework for the provision of free basic water services to vulnerable community members. Another example is the IDP, whose major goal is the promotion of community-based planning for developmental projects to ensure effective participation by community members in the development of solutions for long-term development. Equally, the Debt Collection Policy, which is used to develop municipal strategies, empowers municipalities to exercise their invested powers in debt management.

2.3.5 Challenges in the South African water distribution sector

Most municipalities in developing nations face a myriad of water service delivery challenges, for example, inadequate water supply, unreliable water supply, poor water quality, leakages, poor access to water services, and loss of revenue (Pahl-Wostl et

al., 2020). These challenges have far-reaching consequences, which include increases in water-related diseases, poor hygiene, and a lack of access to safe water (Seward, Xu and Turton, 2023). The United Nations International Children's Emergency Fund (UNICEF, 2017) notes that challenges in water service provision led to high mortality and morbidity rates.

One of the critical challenges affecting most municipalities in developing countries is water loss (Seward et al., 2023). Municipalities trusted with water provision commonly lose large amounts of treated water as both apparent and real losses due to old, dilapidated and unmaintained water infrastructure. This confirms Dos Santos et al.'s (2017) argument that municipalities in most developing countries have a limited urgency to invest in the refurbishment of existing water supply and distribution systems. This has adversely increased real (commercial) water losses, exacerbated water supply instability, and reduced water quality at the point of consumption. Therefore, curtailing water losses through refurbishing water pipes can benefit municipalities and reduce expenses related to water losses, in addition to avoiding disasters.

Like other developing countries, South Africa experiences acute water problems. Naturally, South Africa is a water-scarce country that receives on average 464 mm of rainfall per annum, a figure that is almost half the global average of 786 mm (Lukat, Pahl-Wostl, and Lenschow, 2022). Apart from water scarcity, the water sector in the country faces various other challenges emanating from rising population growth, climate change, pollution, and industrial development (Talanow et al., 2021). While the country faces both physical and economic water resource scarcity, its consumption is greater than the world's average. For instance, domestic water use is approximately 237 litres per person per day, a figure well above the global average of 173 litres per person per day (Department of Human Settlement, 2019).

Most South African municipalities face serious backlogs in key infrastructure maintenance and rehabilitation, resulting in critical real and apparent water losses (Muyunda, 2017; Lukat et al., 2022). Municipalities are typically unreliable due to their exclusive right to provide water services (Talanow et al., 2021). Despite water challenges being a high priority on the South African government's agenda, municipalities are not investing enough financial resources towards new water

networks. As a result, access to portable water services is still a challenge in some areas, mostly rural and low-income communities where populations and water demand are both high (Sutcliffe et al., 2021).

Low water tariffs and high debt impairment are among the challenges experienced by South African water service-providing municipalities. Water tariffs across South African municipalities are not cost-reflective, and municipalities fail to raise enough revenue to sustain and/or improve water service provision (Bischoff-Mattson et al., 2020). This is mainly because water is viewed as a social good as opposed to a commercial good, which makes tariff setting a political issue and not an economic one. Thus, municipalities struggle to come up with reasonable tariffs that reflect the actual cost of water service provision. McPhail et al. (2014) and Nkabane and Nzimakwe (2018) provide thorough discussions of these factors. According to Nkabane and Nzimakwe (2018), South African municipalities are entangled in a cycle of financial unsustainability due to their failure to control and recover operational costs. Further, while water tariffs are relatively low, many South Africans do not pay their water bills. This affects municipal revenue from water services, which is generally insufficient to cover the actual costs of collecting, treating, storing, and transporting water.

The consequence of tariffs that are not cost-reflective is evident in the inability of municipalities to reinvest in additional water infrastructure projects and the repair of ageing water infrastructure (Bischoff-Mattson et al., 2020). Notwithstanding that the DWS is responsible for setting standards for water services and their tariffs, the Municipal Systems Act and the Municipal Finance Management Act regulate the levying of tariffs. This creates considerable challenges in guaranteeing that WSAs charge cost-reflective tariffs that cover running and infrastructure repair costs, in addition to encouraging efficiency in water usage.

South African municipalities additionally encounter a dearth of proficient workers in the technical trades (Buthelezi, 2022). The scarcity of proficient workers in the water purification, chemical, and mechanical engineering sectors in most South African towns has resulted in inadequate management of water quality (Montwedi et al., 2021; Jachimowski, 2017; Khuzwayo and Chirwa, 2020). Modi and Mabhaudhi (2020) asserted that the expertise and competence of employees are critical when evaluating their performance, especially when other elements like motivation are good. The lack

of proficient staff in the water treatment department has hindered municipalities' capacity to successfully attain the needed water quality standards. Therefore, proper and adequate training and development of municipal workers in South Africa is warranted.

Corruption is another critical factor challenging the South African water distribution sector (Paterson, 2022). According to Nkabane and Nzimakwe (2018), corruption at the upper levels of the water supply chain, particularly at the leadership and managerial levels, cripples the water distribution sector. Additionally, corruption reduces the value and accessibility of water services and may result in enormously unbalanced and undesirable water shortage effects on the unfortunate and marginalised in society (Paterson, 2022). To this end, McPhail et al. (2014) argue that some failure to safeguard water sources from pollution and the emergence of poor-quality water infrastructure, which fatally undermines fair and affordable access to water services, are attributable to corruption. Thus, corruption in water resource management has detrimental effects on livelihoods.

The historical backgrounds of most South Africans have experienced irreversible damage (Dube, Nhamo, and Chikodzi, 2022). South African municipalities are negatively affected by the culture of civil disobedience, particularly when it comes to honouring obligations related to public services consumed (Nhamo et al., 2020). This behaviour originated in the apartheid era and involved sabotaging service delivery (Dube, Nhamo and Chikodzi, 2022). According to Kruger (2018), sabotaging public services is evident in the growing proportion of debt impairments. As a result of failure to make payments, the debts owed to municipalities have significantly and rapidly increased over time. Municipal consumer debt is a possible concern that jeopardises the fiscal and financial standing of municipalities and eventually affects the sustainable provision of services.

Furthermore, statistics show that debt owed to South African municipalities totalled approximately R72.4 billion in the 2018 financial year alone (Statistics South Africa, 2020). Such massive debt and high debt impairments cripple the ability of municipalities to meet their obligation to provide public services because municipalities will struggle to finance additional water infrastructure and/or meet their credit obligations for bulk purchases of electricity and water.

Apart from municipal and consumer-related factors, environmental factors also affect the South African water distribution sector (Nhamo et al., 2020). During dry seasons, traditional sources of water dry up at a faster rate, causing water service providers to experience water supplies shortage (Sutcliffe et al., 2016). Thus, in areas where the major sources of water are natural surface water bodies, access to water is heavily affected, which is one of the reasons for water-related challenges being more severe during the dry season. Consequently, people from both rural and urban communities experiencing severe water shortages resort to digging up wells on riverbeds (Fonjong and Ngekwi, 2014).

Additionally, erratic rainfall patterns and climate change resulting from global warming have equally challenged the water distribution sector (Millington and Scheba, 2021). Rainfall patterns have drastically changed, such that while some regions receive excess rains, others experience severe droughts (Matikinca et al., 2020). Some countries are experiencing significantly lower average rainfall levels due to climate change, placing them at increased risk of severe droughts (UNICEF, 2017). Thus, the effects of ongoing climate change and intense weather occurrences, including floods and droughts, exacerbate challenges to the sustainable provision of safe water by municipalities in South Africa (Millington and Scheba, 2021). Lack of adequate water resources due to climate change also has some health consequences and other dire impacts on people's livelihoods (Menne et al., 2018).

On the other hand, fast-growing populations, urbanisation, industrialisation and increasing agricultural activities are also major contributors to the water challenges in South Africa (Menne et al., 2018). Water infrastructures in most urban areas were designed to cater for population levels that were much lower than the current high populations, which are a result of a fast-growing population (Fonjong and Ngekwi, 2014; Tacoli, McGranahan and Satterthwaite, 2015). Equally, increases in irrigation-fed agricultural activities have placed an additional burden on the already overstretched water supply, thus increasing the demand for water resources (Rakodi, 2016). Population growth has led to an increase in agricultural activities to ensure food security, and this has placed a considerable burden on available water resources.

The quality of water in the main river sources is compromised by harmful chemical substances and other industrial waste (Mahlangu and Garutsa, 2014). Additionally,

poor farming practices have resulted in the contamination of water bodies with fertiliser residues and other agricultural chemicals (Leroy, 2019). Poor agricultural techniques consist of inadequate dry-land tillage, incompatible dry-land crop selection, excessive irrigation, unsuitable irrigation technology, insufficient drainage systems, and inefficient irrigation water transportation procedures (Cullis et al., 2016). While poor farming methods have an impact on the quality of water resources, industrial waste discharged into various water bodies plays a significant role in the contamination of water resources.

According to Rakodi (2016), poor water quality, mainly caused by industrial waste disposal, hugely affects municipal budgets and has many effects on the social safety net. More precisely, heavy water pollution increases the cost of water treatment, which imposes a serious financial burden on municipalities. In a perfect world, municipalities would have to increase tariffs to recover the costs. However, this is not the case in South Africa, where water is largely deemed a social good and tariffs are determined by the municipal council (Thornton et al., 2013). High water provision costs and low water revenue for municipalities consequently lead to poor water services (Cullis, Gorgens and Rossouw, 2016). The ultimate consequence is massive service delivery protests.

The obstacles encountered in the South African water distribution system may also be ascribed to inadequate management by local officials (Livingston, 2021). Inconsistencies of this kind often arise in scenarios characterised by limited employee engagement in policy formation (Avison et al., 2016). Typically, workers are more likely to fully engage with programmes that they have contributed to building and may feel less motivated to adopt procedures that have been imposed on them (Avison et al., 2016). Thus, it is essential for towns to embrace and execute leadership styles that facilitate the participation of workers in the formulation and execution of policies. Leaders must not only engage workers in policy formation but also actively advocate for the idea of ongoing quality enhancements and be seen aiding subordinates. Pollitt (2015) suggests that leaders who are more transformative in their approach are the most desired for promoting both employee and organisational practices. This is attributed to the impact that workers have in establishing alignment between the objectives of individual employees and those of the municipality.

Several studies in South African literature suggest that the issue of inadequate water quality management may be attributed to ineffective collaboration and regulatory coordination between the Department of Water and Sanitation (DWS) and local municipalities (Cullis et al., 2016; Toze, 2012). The personnel responsible for overseeing compliance with environmental laws in the DWS, the Department of Cooperative Governance and Traditional Affairs (CoGTA), and the Department of Environmental Affairs (DEA) occasionally neglect their duty to adequately supervise and monitor the municipalities' adherence to the requirements of important legislation (Matlala and Uwizeyimana, 2020). Lack of efficient surveillance ultimately results in the dumping of hazardous trash into aquatic ecosystems, endangering the integrity of water resources and consequently escalating the expenses associated with purifying untreated water. Thus, Rivett et al. (2015) suggest that sufficient enforcement capacity, properly coordinated with the Department of Water and Sanitation (DWS), the Department of Cooperative Governance and Traditional Affairs (CoGTA), and the Department of Environmental Affairs (DEA) is necessary to maintain the quality of water resources.

In summary, there is a greater need for leaders to be cognisant of the challenges associated with the accessibility and reliability of water service provision. Such awareness enables the formulation and implementation of informed policy decisions that can mitigate the detrimental consequences associated with water shortages. Apart from policy formulation and implementation, there is a need to make considerable investments in water infrastructure rehabilitation to ensure the sustainability of its functional efficiency. Additionally, considering the persistent increases in the human population, it is imperative to revisit water services provision strategies to revamp the current water infrastructure to accommodate these increases. Finally, there is a need to encourage the adoption and effective implementation of corporate governance principles to ensure that moral ethics are practised by all involved in the provision of public services.

2.3.6 Common solutions suggested towards water service challenges

Literature provides various solutions to the challenges experienced in the South African water distribution sector (Mishra et al., 2021). Muyunda (2017) suggests that to overcome water service challenges, particularly water shortages due to climate change, there is a need to look after and manage water resources sustainably. For instance, while gradual climate change often poses risks such as changes in biosystems leading to reduced water resource availability, the adoption of possible adaptive abilities is rare. The South African Human Rights Commission (SAHRC, 2018) suggests the need for unprejudiced solutions that reduce the water demand-supply difference to improve water availability. Such solutions would put in place an array of cost-effective measures across supply, agricultural effectiveness, efficiency enhancement, as well as industrial and domestic levers (SAHRC, 2018). This implies that putting concerted efforts into agricultural improvements and adopting industrial and domestic solutions in economic centres will help reduce water consumption, positively impacting water availability.

According to the UNICEF (2019), flooding damages water infrastructure and systems, thus disrupting water provision for prolonged periods. This implies that municipalities need to enhance their preparedness by putting in place measures that reduce the impact of flooding on water supply infrastructure (Serge and Simatele, 2020). The World Health Organisation (WHO) (2019) recommends improving organised evaluations of the climate change vulnerability of all water supply utilities and water-related programmes to implement procedures in high-risk areas. Thus, municipalities can endure the effects of extended droughts on water supply by putting in place water demand management systems, reducing the amount of water that is unaccounted for, and adopting innovative methods of recycling wastewater.

Serge and Simatele (2020) recommend recruiting qualified and competent personnel in the water sector to address water supply challenges experienced by municipalities. The lack of capacity, skills and competence in most municipalities negatively affects the provision of water services (Moyo, 2013). The existing problem is that when water infrastructure and equipment break down, it takes a considerable amount of time to rectify the problems (Bischoff-Mattson et al., 2020). This delay is primarily due to municipalities lacking the requisite expertise within their maintenance departments.

Quite often, municipalities hire external contractors to fix technical problems (Bischoff-Mattson et al., 2020). As such, the Office of the United Nations High Commissioner for Human Rights (OHCHR, 2010) suggested that it is necessary for South African municipalities to ensure that their human resources policies place emphasis on competence-based employment for critical positions. This then reduces the dependence on outsourcing and ensures sustainability.

The United Nations Human Rights Council (UNHRC, 2020) identified the need to implement a proactive infrastructure maintenance programme to ensure the continued usability of reservoirs, borehole pumps, reticulation pipes and public water taps. Poor maintenance programmes make municipalities susceptible to both real and apparent water losses due to damaged or ageing infrastructure. This can be prevented by implementing effective maintenance programmes. For example, municipalities should implement preventative maintenance programmes that are proactive (UNHRC, 2020). The reason is that poor maintenance of water infrastructure rapidly damages the infrastructure, which is often already old. This will consequently reduce the infrastructure's expected productivity and useful life. On the other hand, regular maintenance ensures the reliability of the municipality's water infrastructure.

Political meddling is commonly identified as one of the main drivers of the water supply challenges across South African municipalities (Lebek, Twomey, and Krueger, 2021). Most municipalities do not prioritise water affairs when spending public funds due to political meddling in the decision-making processes (Lebek et al., 2021). Political progressions typically influence the use of public funds in most municipalities, resulting in a low priority for water service expenditures (Nel, 2012). This implies that there is a need for practising good corporate governance in municipalities and the effective separation of duties between politicians and the management of the municipality. Additionally, inclusive engagement by political leaders will help ensure that decisions are a product of the public.

Considering the above, it is imperative to note that in dealing with the challenges associated with climate change, municipalities should effectively utilise their adaptive abilities. With respect to challenges caused by flooding, there is a need to enhance the state of preparedness through establishing measures that curtail the impact of floods on water infrastructure. Furthermore, the recruitment of competent personnel

can adequately solve the problems resulting from deficiencies in expertise in municipalities. Finally, the implementation of a proactive maintenance strategy can ensure sustainable access to water infrastructure, while the practice of good corporate governance will instil ethical behaviour across South African municipalities.

2.4 Conclusion

This chapter presented the literature review of the study. Three theories underpinning the study were discussed, namely the open systems theory for water management, the water supply reliability theory, and the differential tax theory. These theories provided a foundation that links the objectives of the study to the theoretical framework of the public administration domain. Subsequently, the chapter presented a discussion of the empirical literature linked to the study. The first subsection discussed the South African water distribution sector and its key players. The second subsection addressed key legislation governing the South African water distribution sector. Following this, the chapter examined key policies that serve as guidelines for the water distribution sector in South Africa. It then delved into the challenges facing water distribution in South Africa. Finally, proposed solutions to these challenges based on existing literature were explored. In summary, this chapter provided a strong foundation for the study, positioning it in the literature. The next chapter discusses the methodology of the study.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This study aimed to establish the determinants of water service delivery challenges in a selected South African district municipality. To achieve this aim, the study addressed three main objectives regarding the provision of water services in the selected district municipality. This chapter presents the methodology that frames and facilitates the achievement of the outlined objectives of the study. The chapter is organised into several sections. It first presents a discussion of the methodological choice adopted in the study. This is followed by discussions of the study site and population, the study samples, and the adopted sampling techniques. Additionally, a discussion of the survey instruments used, the data collection processes, and the data analysis procedures is provided. Subsequently, the chapter discusses ethical considerations as well as the delimitations of the study. Finally, a summary concludes the chapter.

3.2 Research paradigm

In research, a paradigm is used to explain philosophical assumptions, a collection of beliefs, and a set of opinions that guide a researcher's actions and worldview (Kaushik and Walsh, 2019). It provides a platform for shared values and beliefs in understanding reality and knowledge (Shan, 2022). This study was grounded on a pragmatic research philosophy, which is founded on the historical contributions of pragmatist philosophy that considers reality from a plurality standpoint (Kelly and Cordeiro, 2020). A pragmatic paradigm embraces the researcher's consideration of using a philosophical or methodological approach that is relevant to the research problem (Kaushik and Walsh, 2019). It perceives a mixed-method research approach as favourable to provide practical solutions to the study (Clarke and Visser, 2019). This study followed a mixed-method approach to understanding determinants of water

service delivery challenges in HGDM. Shan (2022) revealed that pragmatism accepts the existence of multiple realities as well as supports the opinion that there is an objective reality which can be constructed through human experience. This provided a philosophical underpinning that knowledge and reality are socially constructed through engaging individuals' experiences.

3.3 Research approach

Taherdoost (2022) identifies three broad dimensions of methodological choices, namely, quantitative, qualitative, and mixed-method approaches. Quantitative research involves mathematical and statistical analyses through a process that quantifies response categories (Mortoja, Yigitcanlar and Mayere, 2020). On the other hand, a qualitative approach involves a detailed and comprehensive study of the respondents' experiences, attitudes, and views, where data is in the form of words (Babbie, 2020). Moreover, Mortoja et al. (2020) contend that quantitative research techniques yield measurable results in the form of both continuous and non-discrete numerical values, while a qualitative strategy produces linguistic outputs that include describing discoveries using words. To leverage the benefits of both quantitative and qualitative methodologies, several researchers choose a mixed-method approach, which entails using both techniques within a single study (Babbie, 2020).

This study adopted a mixed-methods approach to examine the determinants of water service delivery challenges in the HGDM. The mixed-methods methodology takes advantage of the strengths of quantitative and qualitative research methodologies (Creswell, 2021). This ensures comprehensive findings are generated. In the context of this study, a mixed method elicits comprehensive and detailed information from both water services practitioners who implement water policies in municipalities and residents who are the recipients of water services. Thus, comprehensive qualitative data is solicited from managers, supervisors, and technicians through interviews, while quantitative data is collected from the residents through a survey. In this form, qualitative and quantitative research methods are combined to guarantee triangulation by corroborating results. Triangulation, in this context, tests validity by combining information from water service practitioners and consumers.

3.4 Empirical setting

This study was conducted in the HGDM, located in south-west KwaZulu-Natal (KZN), South Africa. HGDM consists of four local municipalities, namely, the Ubuhlebezwe, Dr Nkosazana Dlamini Zuma, Greater Kokstad, and Umzimkhulu local municipalities. The district has a total population of approximately 558 000 people (Statistics South Africa 2020). The racial distribution of the population in the district is approximately 97% Black, 2% Coloured, 1% White, and 0.4% Indian/Asian (Statistics South Africa, 2020). According to Statistics South Africa (2020), the district has approximately 123 013 households. The proportion of females in the district is slightly higher than that of males, with the former constituting about 53% of the population (Statistics South Africa, 2020). In terms of the local economy, the HGDM is predominantly rural, with agriculture and agro-processing activities being the most dominant economic activities. Figure 3.1 shows the location of the HGDM on the South African map, as well as the map of the district municipality in terms of the spatial locations of its four local municipalities.

Panel A: Position of the Harry Gwala District Municipality on the South African map
Source: Coetzee et al. (2018)

Panel B: The map of the Harry Gwala District Municipality
Source: https://municipalities.co.za/map/118/harry-gwala-district-municipality

Figure 3.1: Maps of South Africa and the Harry Gwala District Municipality

The Water Service Authority (WSA) is responsible for the provision of potable water services across the Harry Gwala District Municipality's four local municipalities. The Water Services Department of the municipality has three units that work together to fulfil the municipality's water services provision mandate as specified in the Constitution of the Republic of South Africa (1996) and the various water-related

legislations. The three units of the Water Services Department are the Research, Planning and Design Unit, the Water Governance and Customer Care Unit, and the Operations and Maintenance Unit. Each of these units has specific roles that complement each other in terms of efficiency and effective water service provision.

The Research, Planning and Design Unit is responsible for planning new projects and developing master plan documents like the Water Services Development Plan (WSDP). On the other hand, the Water Governance and Customer Care Unit is the regulatory arm of the department, whose mandate is to oversee municipal compliance with national standards, norms, and regulations while implementing sustainable policies that maximise residents' satisfaction with water service delivery. The Operations and Maintenance Unit is the largest, with complex duties involving the provision of proper systems for the efficient delivery of potable water services.

As of March 2022, the Water Services Department at the HGDM had a staff complement of 226 employees (Harry Gwala District Municipality, 2022). These employees include of the head of department, three senior managers, six managers, a chief technician, three technicians, five superintendents, seven administrative staff, and 200 field workers. The municipality was chosen as the ideal case study due to its continuous experiences with water service delivery protests. The protests typically turn violent, resulting in vandalism and damage to property (eNCA News, 2019; Harry Gwala Mayoral Performance Report, 2022). Furthermore, residents in some areas have no access to potable water services and fetch water from rivers (Harry Gwala Mayoral Performance Report, 2022). Therefore, it is critical to examine the key drivers of the water services challenges in the municipality.

3.5 Study population, sampling, and sampling size

A target population describe the overall population from which study conclusions will represent (Berndt, 2020). It represents the segment of the population from which a survey is conducted. The study's sample includes two components. Residents provide the first sample for the quantitative elements of the study. Municipal employees provide the second sample for the study's qualitative element. The Raosoft sample size calculator was used to determine the sample size for the quantitative component.

The adopted Raosoft formula has an error margin of 5%, a confidence level of 95%, and a 50% response distribution. Based on these parameters, 412 respondents are a sufficient sample size for a total population of 558 000 people. Therefore, quantitative data were collected from at least 412 respondents across the four local municipalities of the HGDM. The study targeted household heads as respondents. Due to variations in statistics, the district municipality's overall population of 558 000 does not distribute evenly across the four local municipalities. Therefore, the target sample drawn from each local municipality is proportional to the municipality's population divided by the total population of the district municipality. The population distributions of each local municipality according to Statistics South Africa (Stats SA, 2020), as well as their proportion and target sample size to be drawn from each local municipality, are presented in Table 3.1.

Table 3.1: Number of targeted respondents from each local municipality

Local municipality	Total population	Proportion	Sample size
Greater Kokstad	106 753	20%	80
Dr Nkosazana Dlamini –Zuma	125 610	23%	105
uBuhlebezwe	118 346	21%	95
uMzimkhulu	197286	36%	132
Total	**558 000**	**100**	**412**

Source: Own table computed using population statistics from Stats SA (2020)

The table shows that 80 respondents were drawn from the Greater Kokstad local municipality, 105 from Dr Nkosazana Dlamini-Zuma local municipality, 95 from the uBuhlebebezwe local municipality and 132 from the uMzimkhulu local municipality. These sample sizes were calculated based on the proportion of each local municipality's population to that of the district municipality. Thus, the population of these local municipalities was, respectively, 20%, 23%, 21%, and 36% of the district's population. Reports of water service delivery protests guided the study's choice of local municipalities to survey (Harry Gwala District Municipality, 2018). Therefore, areas that experienced water service delivery protests in the past three years were selected. Therefore, surveys are conducted in the Fairview Township and Morningview (Ubuhlebezwe Local Municipality), Ibisi township (Umzimkhulu Local Municipality), the

Sonyongwana, Ngwagwana, and KwaSpheni rural areas (Dr Nkosazana Dlamini Zuma Local Municipality), as well as the Swartberg and Wansberg rural areas (Greater Kokstad Local Municipality). The fact that these areas are less developed and typically impoverished households links them together.

The study conducted in-depth interviews with fifteen municipal employees at different levels of the organogram as part of its qualitative component. More precisely, the study targeted professional opinions from three managers, three technicians, and nine fieldworkers. Sampling was conducted until data saturation was reached. Saturation in this context implies that sampling continues beyond the 15 targeted participants if new information continues to emerge. The interviews are stopped when no new information emerges from the participants (Vasileiou et al., 2018). In-depth interviews with the targeted 15 practitioners were expected to provide professional views and opinions from the perspective of the WSA. The three groups of practitioners were targeted because they deal with water service issues daily at a professional level; thus, their experiences and knowledge were expected to highlight the key issues investigated in this study. Criteria for inclusion in the study specified that participants must be currently employed in the Water Services Department at the Harry Gwala District Municipality. Therefore, any other employee not currently employed by the Water Services Department at the Harry Gwala District Municipality is excluded from the study and not interviewed.

3.6 Sampling techniques

Sampling is the science of choosing participants who will be involved in the study (Etikan, Musa and Alkassim, 2016; Pascoe, 2014). Two main classes of sampling techniques are applied: probability sampling and non-probability sampling. In non-probability sampling, respondents are selected based on the judgment of the researcher, whereas in probability sampling, they are randomly selected (Denzin and Lincoln, 2011). The random element of selecting respondents under probability sampling makes the selection process objective, unbiased, and more representative (Pascoe, 2014). However, non-probability sampling methods use subjectivity in the

selection of respondents, which has the disadvantage of not representing the entire population (Pascoe, 2014).

There are several variations available for each category of sampling methods. Singh and Mangat (2013) identified several probability sampling strategies, including simple random sampling, systematic sampling, stratified sampling, and cluster sampling. Quantitative research uses probability sampling techniques in the majority of situations. This study used the basic random sampling procedure to choose 384 participants for polling. The simple random probability sampling approach employs a random selection strategy whereby every respondent in a population has an equal possibility of being chosen to participate (Singh and Mangat 2013). The reason for using this sampling strategy for the quantitative aspect of this research is that it removes any bias in the selection of participants since every individual in the target group has an equal probability of being chosen (Daniel, 2014).

Non-probability sampling methods include quota sampling, convenience sampling, judgmental (purposive) sampling, expert sampling, and maximum variation sampling (Daniel, 2014; Doherty, 2014; Pascoe, 2014). This research used the purposive (judgemental) non-probability sampling strategy to choose participants for the interview. Purposive sampling is a commonly used strategy in qualitative research, particularly when researchers have few resources at their disposal (Creswell, 2021). Purposeful sampling is used when a researcher has a specific target population in mind with a realistic expectation of obtaining sufficient and relevant information (Creswell, 2021; Doherty, 2014). The purposive sampling technique was selected for this study due to the limited professional knowledge about the water service provision challenges experienced in the HGDM. Therefore, water services practitioners such as managers, technicians and fieldworkers were purposefully selected to participate in this research because they have more reliable knowledge about the determinants of water provision challenges in the municipality.

3.7 Data collection instruments

Boyce and Neale (2014) define data collection instruments as tools that contain questions used to collect data for the study. This study used two data collection

instruments, namely, a questionnaire and an interview schedule. The former was used to collect quantitative data from households sampled across the municipality, while the latter was used to collect qualitative data from employees sampled from the Water Services Department of the municipality. The construction and structure of each of these two instruments are discussed in this section.

3.7.1 Household survey's questionnaire construction and structure

A questionnaire is an instrument used to collect quantitative data in a survey. It contains closed-ended questions with guided answers for gathering quantifiable information from survey respondents (Fife-Schaw, 2020). Basias and Pollalis (2018) argued that a questionnaire is a predetermined written collection of questions that survey respondents choose from to provide their replies. According to Grassini and Laumann (2020), closed-ended questions require respondents to provide predetermined choices as replies and discourage long discussions. They make it easy and quick to collect data from a larger population at a lesser cost (Monette et al., 2014). The questionnaire for this study was developed in English. Most of the questions were derived from the existing literature on water service delivery. The questionnaire has two main sections: the first section contains questions on the biographic details of respondents, and the second section contains questions aligned to the objectives of the study. The questions in the second section pertain to water service challenges and the drivers of those challenges from the perspective of households. These questions are predominantly closed-ended, with corresponding fixed-choice answers on a Likert scale. The study's questionnaire is attached as Appendix 1.

3.7.2 Interview schedule construction and structure

An interview schedule is a data collection instrument that contains pre-compiled questions used to interview respondents (Magaldi and Berler, 2020). This study used semi-structured interviews to collect qualitative data from municipal employees. Thus, an interview schedule that contained mostly open-ended questions was developed. The advantage of open-ended questions is that they do not restrict the amount of

information a respondent provides to a question (Mashuri et al., 2022). Therefore, they enhance the possibility of obtaining detailed and comprehensive answers, which foster a better understanding of the investigated phenomena. The interview schedule for the study was developed in English. Questions contained in the interview schedule were compiled from the existing literature and modified to address the practical water supply challenges experienced in the Harry Gwala District Municipality. The interview schedule consists of three sections. The first section contains questions on the biographic characteristics of the participants, while the second section contains questions related to water supply challenges. The third section contains questions on the impact of water supply challenges. The interview schedule used to collect qualitative data for this study is attached as Appendix 2.

3.7.3 Testing instruments for reliability and validity

Pretesting of survey instruments is imperative because it ensures that there are no flaws or ambiguities in the construction of the questions (Adeoye-Olatunde and Olenik, 2021). Thus, pre-testing ensures that flaws, mistakes, ambiguities, stereotypes, and prejudicial statements are identified and removed before the actual data collection (Kumar, 2019). More precisely, pre-testing improves the validity and reliability of research instruments. The questionnaire and interview schedules designed in this study were tested for reliability and validity. Details on pre-testing are discussed in this section.

3.7.3.1 Reliability Testing

Reliability emphasises the level to which a measure of a construct is consistent (Grgic et al., 2020). There are three main types of reliability in the literature, namely, internal consistency reliability, inter-rater reliability, and test-retest reliability (Kumar, 2019; Basias and Pollalis, 2018). Internal consistency and reliability determine how well an instrument measures what is intended to be measured (Eagan et al., 2020). Thus, it measures the degree of inter-relationship among the items on an instrument, such that they are consistent with one another and measure the same thing (Kumar, 2019). On

the other hand, the inter-rater reliability test measures the extent to which findings are consistent and reliable if different rates are used, while the test-retest approach measures the consistency of results over time (Eagan et al., 2020). Using the test-retest approach, the same participants are tested twice at different times and locations to establish the consistency of their findings.

Cronbach's alpha measurement tests reliability and determines the level of internal consistency. The Cronbach's alpha coefficient varies from 0 to 1, where a coefficient of 0 implies unreliability, while a coefficient of 1 signifies extreme reliability. In the literature, a minimum coefficient of 0.7 is a preferable indicator of a reliable instrument (Humphries, 2017). The Cronbach's alpha is particularly useful for assessing the reliability of a scale by measuring the consistency of items within scales that measure a single concept. The Cronbach's alpha coefficient is widely used as the primary indicator of internal consistency in research studies using several Likert scale questions. Its purpose is to assess the reliability of the scale (Humphries, 2017). The Cronbach's alpha coefficient is a straightforward method for assessing the reliability of a score. Several items are used to measure the same underpinning concept (Weber, 2017).

Reliability assesses quantitative research methodologies. Sürücü and Maslakçi (2020) argued that validity and reliability are important considerations for qualitative researchers when conducting a study, evaluating outcomes, and assessing the study's quality. Reliability and validity are critical for ensuring quality in quantitative paradigms. In qualitative paradigms, however, credibility, dependability, transferability, and confirmability are the fundamental requirements for quality (Lincoln and Guba, 1985). Lincoln and Guba (1985) described dependability as analogous to the idea of reliability in quantitative research. Lincoln and Guba (1985) highlight the use of inquiry audits as a potential method to improve the reliability of qualitative research. These audits may be used to assess the coherence of both the procedure and the outcome of the investigation (Creswell and Poth, 2018). Similarly, Saunders et al. (2016) support the idea of dependability by equating it with consistency or reliability in qualitative research. Data transferability is accomplished by verifying the research stages using the inspection of various objects, such as raw data, data reduction products, and process notes (Saunders et al., 2016). Reliability in qualitative research pertains to the

consistency of replies across different coders analysing data sets. This consistency is improved by thorough field notes, the use of recording equipment, and the transcription of digital files.

3.7.3.2 Testing for validity

Validity emphasises that the level of an instrument adequately represents the underlying construct that it is intended to measure (Dunn, 2020; Saunders et al., 2016; Strauss and Corbin, 2010). Common types of validity in the literature are criterion validity, content validity, construct validity, face validity, and concurrent validity (Saunders et al., 2016; Borrego et al., 2015). While each of these types has its own advantages, this study uses face validity, content validity, and construct validity. Face validity assesses the validity of the research instrument by merely looking at how it is structured, while content validity tests whether the content of the questions in the instrument fully represents what should be measured. However, construct validity describes the extent to which the instrument's content covers all the research objectives (Weber, 2017).

In this study, content validity is ensured by the supervisor, who is an expert in the subject and can provide a critical review of the instruments, that is, whether the instruments contain all relevant content (and questions) that fully cover issues that are the focus of the study. Face validity and construct validity are ensured by giving both the questionnaire and interview schedule to some experts in the examined field. Thus, the instruments were presented to three employees in the Water Services Department at the Harry Gwala for a critical review of the questions in line with the objectives of the study. Prior to this, an extensive literature review was conducted to design questions that were guided by the literature. Thus, existing academic literature, government documents and news articles were extensively consulted to design relevant questions about the phenomena examined. Furthermore, advanced drafts of the instruments were piloted to check for simplicity, foster understanding, remove ambiguous words and rephrase unclear statements. In this regard, the questionnaire was piloted on ten residents from the HGDM, and the interview schedule was piloted on the three employees mentioned earlier. The data collected from the pilot surveys

were not included in the final analysis. It was used to identify uncertainties and flaws that needed to be corrected to improve the research instrument.

3.8 Data collection procedure

Data collection describes a systematic process of collecting data on the variables of interest with the intention of addressing the research objectives (Creswell, 2021). Precision in data collection is essential for more robust data to be collected. The data collection process in this study involves two phases. The first stage is the collection of quantitative data from residents of the HGDM, while the second step is the collection of qualitative data from employees at the Water Services Department of the Harry Gwala District Municipality. The study was approved by the institution through the provision of full ethical approval prior to data collection. The ethical clearance is attached as Appendix 3. A discussion on each of these phases is given in this section. A complete permission letter from the faculty of the research ethics committee was obtained prior to data collection.

3.8.1 Collection of quantitative data from households

Quantitative data were collected from household heads who were selected using the random sampling method in the selected target areas of the four local municipalities. As explained in the sampling approach section, sampled households included both townships and rural residents. The survey was administered by the researcher, and the questionnaire was completed in the presence of the researcher. This approach allows the researcher to clarify questions that may not be clear to respondents. Although the questionnaire was designed in the English language, the researcher is conversant in both English and IsiZulu. In critical circumstances, researchers translate and interpret questions for non-English-speaking respondents.

Prior to data collection, a letter of information detailing what the study is about was provided to each respondent. The letter of information informs each respondent about their right to opt out, among other key rights. A detailed list of the information used in

this study is given in Appendix 1. After reading the letter of information, each respondent was encouraged to sign an informed consent form. The signed informed consent allowed the researcher to proceed with data collection from each respondent. The consent letter used in the study is attached as Appendix 1.

Data collection occurred at a time when South Africa was battling the COVID-19 pandemic. Consequently, the government implemented several health and safety protocols that needed to be followed to minimise the spread of COVID-19. In adherence to the gazetted protocols, attempts were made to minimise the chances of any physical contact and ensure that a physical distance of at least 1.5 metres between the researcher and the respondent was maintained during the data collection process. Both the researcher and participants correctly wore face masks that covered their mouths and noses throughout the survey. Finally, the researcher carried a bottle of sanitiser, and both the researcher and each participant sanitised their hands before, during and after the survey.

3.8.2 Collection of qualitative data

The qualitative data collection included conducting semi-structured and in-depth interviews with the employees at the Water Services Department of the HGDM. A gatekeeper's permission to conduct interviews with the employees was obtained from the Executive Director of the Water Services Department and is attached to this study as Appendix 6. A letter of information containing the aim, objectives, and significance of the study, as well as the rights of participants, was also presented to each participant, as explained in the previous section. Furthermore, informed consent was obtained from each targeted participant before each interview. Obtaining consent is a key ethical consideration that must be complied with before the commencement of data collection (Vikas et al., 2021). All respondents received the same informed consent as explained in the previous section.

After each possible participant acknowledged the informed consent form, the interviews were conducted with each participant at a time that was convenient to them. Due to the COVID-19 protocols, data was collected using virtual platforms like MS Teams and Zoom. These platforms entail no physical contact between the researcher

and participants. However, it is important to note that some participants preferred face-to-face interviews; hence, interviews took place in well-ventilated rooms with both the researcher and participant correctly wearing face masks, covering their mouths and noses throughout the interview session. A socially acceptable distance of at least 1.5 metres was maintained between the researcher and each respondent throughout the session. Hands were sanitised before, during and after the session, and no direct physical contact occurred between the researcher and each participant.

Interviews were conducted in English; this was possible because the target group comprised managers, technicians and fieldworkers, who were expected to be conversant in the language. However, participants who preferred to speak IsiZulu were allowed to do so; thereafter, the data is translated into English for transcription and coding. This was possible because the researcher is conversant in both English and IsiZulu. Each interview was scheduled to last approximately 30 minutes. They were recorded using audio recording facilities available on virtual platforms and audio recording gadgets in the case of face-to-face interviews. Each participant was informed that the session was being recorded prior to the session. Furthermore, notes on emerging key points were recorded on a notepad. The collected data was stored in electronic format on password-protected external drives and will be discarded after a period of five years.

3.9 Data analysis

Data analysis involves sorting and organising survey data to derive meaning (Nasir and Sukmawati, 2023). It is a process that involves inspecting, cleaning, transforming, and modelling data to unearth information that is useful and inform conclusions about a phenomenon (Creswell, 2021). According to Monette et al. (2014), the data analysis process involves analytical and logical reasoning to gain information from the data. Data analysis primarily aims to extract significance from data, enabling the obtained insights to support rational decision-making. Data analysis was conducted in two distinct stages within the framework of this research. The first step entails the examination of quantitative data obtained from residents, whereas the subsequent phase comprises the study of qualitative data gathered from employees.

3.9.1 Analysis of quantitative data

The quantitative data collected from residents were analysed in two main parts. The first part involved the use of descriptive statistics and frequency distribution statistics. These two categories of statistics effectively arrange survey data in a logical and comprehensible way, facilitating the identification of trends within the data (Welman, 2015). In most cases, descriptive statistics are used to summarise key variables and are usually presented using tables and graphs. In the context of this study, tables showing the means, minimum, maximum, standard deviations, and modal statistics were used to reflect the characteristics of respondents and graphs were used to show the distribution of responses.

Second, the principal component factor (PCF) was used to ascertain the drivers of water service delivery challenges in the HGDM. PCF, a widely used statistical technique for dimensionality reduction, helps researchers analyse complex datasets by transforming many variables into a smaller set of uncorrelated variables that capture most of the important information. PCF is a statistical technique used to reduce the dimensionality of a dataset while preserving the most important information (Cunningham, Cobb, and Jha, 2022). As a linear dimensionality reduction technique, PCF is instrumental in identifying patterns in high-dimensional data. It projects data onto a lower-dimensional space, capturing the most variance in the data. The principal components are ordered based on the amount of variance they explain (Cunningham et al., 2022). The PCF uses eigen analysis, and its results are ordered in descending order, setting the variables in order of significance. The eigenvalue shows the total variance described by each principal component, where components that have eigenvalues greater than 1 are chosen. The mathematical formula for PCF is shown as:

$$y_{ij} = \mathbf{a}_i'\mathbf{b}_j + e_{ij} \;\; i = 1, \ldots, n. j = 1, \ldots$$

where y_{ij} are the elements of $\mathbf{Y}$,$\mathbf{a}i$ (scores), and $\mathbf{b}j$ (loadings) are f-vectors of parameters, and e_{ij} are independent homoscedastic residuals. In the case of factor analysis, the scores $\mathbf{a}i$ are random rather than fixed, and the residuals are allowed to be heteroskedastic in j. It then follows that $E(\mathbf{Y})$ is a matrix rank of f, with f typically substantially less than n or p.

The first component captures the most variance, followed by the second, and so on. By focusing on the first few principal components, which typically capture a significant portion of the total variance, researchers can effectively reduce the data's dimensionality while retaining the most important information. A key benefit of PCF is that the principal components are uncorrelated with each other (Bloomfield and Fisher, 2019). This simplifies the analysis and interpretation of the data, as researchers will not have to worry about complex interactions between the original variables. The Kaiser-Meyer-Olkin (KMO) test, commonly used to assess the suitability of data for a technique as part of PCF and to measure sampling adequacy. Estimation results from unrotated and rotated PCF models were done, and the results are outlined in the next chapter. Furthermore, the PCF model, which falls under the group of factor analysis models, was used to establish the key determinants of water supply challenges in the Harry Gwala District Municipality.

Consistent with the context of this study, data analysis using PCF involved several steps. The first step involved collecting data through a survey with 17 questions related to water supply challenges. Each question was answered on a 5-point Likert scale. With 17 questions, the data with high dimensionality was identified. The existence of data with high dimensionality implied that there were many variables to analyse, which can be complex. Since PCF helps with dimensionality reduction, the researcher identified underlying patterns in the data and grouped related questions together. These groups are called "principal components”.

The second step involved the identification of key determinants. In this study, PCF identified seven factors (out of 17), such as politics, illegal connections, insufficient funds, mismanagement, exclusion of the community and industrial pollution, as the most important determinants. PCF was beneficial for analysing quantitative data because it simplified the analysis**.** By reducing the number of variables, PCF made it easier to understand the relationships between factors affecting water supply. Since PCF required key factors to be identified, the technique enabled the researcher to highlight the most critical determinants, further allowing the researcher to focus on the most impactful areas for improvement.

The Cronbach's alpha test was used to assess the reliability of the data. Cronbach's alpha is a statistic used to assess the internal consistency or reliability of a set of

survey items (Kumari et al., 2023). It essentially measures how well the items on a scale or test measure the same underlying construct (Kumari et al., 2023). A higher Cronbach's alpha score of 0.90 and above indicates excellent reliability (rare in the social sciences), whereas a score of 0.80 to 0.90 indicates strong reliability, and a score of 0.70 to 0.80 indicates acceptable reliability (Kumari et al., 2023). In other words, the items in the survey are likely to be measuring the same thing. Ideally, a researcher would want an alpha of 0.70 or above (Watkins, 2021). A lower Alpha score suggests weaker internal consistency, meaning that the items may not be measuring the same construct effectively.

3.9.2 Analysis of qualitative data

The literature identifies various methods for analysing non-numeric data collected using interviews. The most common methods are thematic analysis, discourse analysis, content analysis, narrative analysis and grounded theory (Ruggiano and Perry, 2019). According to Terry et al. (2017), thematic analysis is aimed at establishing, analysing and reporting data sequences, while discourse analysis focuses on analysing language involving real text, which may include vocal or sign language. Conversely, content analysis is employed to create replicable and valid implications by interpreting and coding textual material, including verbal and graphic communications (Duriau et al., 2007). Narrative analysis exists when respondents engage in sharing and recounting an experience or event (Herman and Vervaeck, 2019). According to Charmaz (2006), grounded analysis is an inductive method of emerging theory that entails generating a theory through the collection and analysis of data and the elucidation of how a social occurrence works.

Each of the qualitative data analysis techniques has its own advantages and disadvantages. The advantages and disadvantages of each technique are detailed in the literature (Coyle and Lyons, 2007; Duriau et al., 2007; Kumar, 2010). Given the focus of this study, the thematic data analysis technique was adopted. Thematic analysis is an appropriate method for understanding experiences, thoughts, or a data set. It is highly flexible and can easily be adapted to analyse data such as common drivers and determinants of water challenges affecting communities. Generally, the

thematic analysis adopted in this study will involve identifying the core themes that emerged from the in-depth interviews conducted with municipal employees. Kumar (2010) provides the five key steps involved in the thematic analysis technique. Table 3.2 presents these steps as modified to suit the objectives of this study.

Table 3.2: Steps followed in qualitative data analysis

Step	Explanation
1. Familiarisation	This step involves going through participants' responses to understand the meaning conveyed (Kumar 2010). Thus, listening and re-listening to the interview recordings will familiarise the researcher with the data.
2. Identifying the thematic framework	Dominant and emerging data patterns from the data will be identified. Main ideas will be written down and coding from the stream of data will be done. After coding, data will be put into different categories depending on their intended meaning. This will be done in alignment with the research objectives. Irrelevant data will be removed with great care to avoid losing valuable data.
3. Indexing	Data will be transcribed, and dominant ideas will be indexed to become themes. The researcher's judgement will be used to index data into themes.
4. Charting	Data is rearranged into a sequence of charts combining data with similar codes from all data sources into one place. The thematic framework will be used to develop charts since it helps to create logic linked to the research aim and objectives from the data.
5. Mapping and interpretation	A graphical and visual thematic map illustrating how the themes relate to each other will be created.

Source: Author's own table

3.10 Ethical considerations

Ethical considerations are crucial for a researcher, as they guide a researcher in a manner that is both morally and legally acceptable (Pietilä et al., 2020). It also prevents the implementation of actions that are deemed ethically unacceptable. Ethical considerations include obtaining informed consent, maintaining confidentiality, anonymity and reflexivity, and ensuring the data's trustworthiness. Each of these

ethical considerations was taken into consideration in this study and is discussed in this section.

3.10.1 Informed consent

Pietilä et al. (2020) emphasise that informed consent is an essential aspect of research, which demonstrates that researchers have acted ethically by explaining all the respondent's rights and obligations in the research. Dehalwar and Sharma (2024) posited that informed consent should include explanations to potential respondents of their right to withdraw from the research process at any time without any consequences. Prior to conducting the study instrument, it is necessary to obtain informed permission from the respondents (Dehalwar and Sharma, 2024). The process of obtaining ethical permission from participants requires providing complete and transparent information about the nature of the study, including the research's purpose and aims, as well as the rights and responsibilities of the individuals involved (Pietilä et al., 2020).

Informed consent is an important ethical consideration that involves providing potential respondents with all explanations and other important details that empower them to make informed judgements about voluntary participation. Informed consent provides participants with the option to engage in the survey without coercion (Shaw, 2023). It helps avoid possible litigation by respondents who might accuse the researcher of having hidden certain information that, if they had known, would have discouraged participation in the study. In this study, informed consent was ensured by providing all the respondents with explanations about the aims of the research and their rights and obligations to the research before the commencement of data collection. The collection of data from the respondents was done after securing informed consent. Respondents were asked to sign a consent form, as indicated in Appendix 2. This follows the provision of all information related to the study in the letter of information that is provided in Appendix 1. Prior to data collection, each participant was informed that their participation is voluntary, and they can discontinue participation at any given time should they feel uncomfortable.

3.10.2 Confidentiality and anonymity

Coffey and Atkinson (2015) define confidentiality as the practice of avoiding disclosing protected study data to unapproved third parties without the explicit permission of the participants. Conversely, anonymity signifies the practice of concealing or withholding the names and personal details of individuals from the public (Atkinson, 2015; Kumar, 2014). Both secrecy and anonymity safeguard responders from potential victimisation. This project maintained stringent confidentiality and security measures to protect all participant information and prevent unlawful access. Confidentiality was ensured by securely storing participants' information and preventing unauthorised disclosure. To safeguard the confidentiality of customers, the study instrument omitted participants' personal information, including their names, residences, phone numbers and job descriptions. Participants were identified using numbers or anonymous identities when authentication was required.

3.10.3 Reflexivity

Reflexivity entails being self-aware of how one's own perceptions, behaviours, and beliefs can affect the analysis and interpretation of data (Parahoo, 2006). It ensures that the credibility of results is maintained by minimising the risk of bias. Therefore, reflexivity is a critical tool for the researcher's critical self-awareness throughout the research process. Reflexivity is directly linked to the maintenance of validity in qualitative research outcomes (Jamieson, Govaart, and Pownall, 2023). It helps to maximise the credibility of findings by reducing the risk of bias. Reflexivity was maintained in the study by engaging in constant dialogue with respondents, developing critical self-awareness during the research process, and keeping a record of key issues that impacted the research. This is necessary to reduce researcher subjectivity and bias emanating from beliefs, norms and personal preferences.

3.10.4 Trustworthiness

Trustworthiness pertains to the level of trust that is put in the data, its interpretation, and the methods used to ensure its quality (Adler, 2022). Given that the study employed a mixed-method design, the concept of trustworthiness was maintained by incorporating credibility, dependability and transferability throughout the research process. Credibility pertains to the degree to which the research results may be connected to reality to verify their accuracy (Taylor et al., 2015). Triangulation guaranteed the credibility of this study. Dependability is the measure of how well the results align not just with the actual data obtained but also with the findings of previous researchers in terms of resemblance, interpretations, and conclusions (Saunders et al., 2016). The researcher conducted a data audit to assess the reliability and trustworthiness of the data. Crucially, the study outcomes are consistently linked to the data gathering instrument. Transferability, in this context, refers to the degree to which readers receive sufficient evidence to apply the results to comparable locations, circumstances, timeframes and people (Saunders et al., 2016). To guarantee transferability, the research included detailed descriptions of the socio-economic and cultural settings and surroundings in which the data was collected (Stahl and King, 2020). Conformability refers to the extent to which other individuals agree with or support the study results (Saunders et al., 2016). This is accomplished through the process of meticulously verifying and validating the data to guarantee its accurate transmission to the results.

3.11 Delimitations of the Study

Delimitations of research refer to the specific limits, exclusions, and reservations that need to be considered while implementing the study (Creswell, 2021). Each reputable research project is subject to delimitations, which define its constraints, restrictions and constraints (Creswell 2021). Researchers identify and articulate delimitations to explain what their studies cover and fail to cover. This study does not generalise its findings to all municipalities in South Africa. The country has various categories of municipalities that have distinct dynamics; hence, the results of the study apply to the

HGDM and should be read and interpreted with caution if applied to other municipalities.

3.12 Conclusion

This chapter discussed the methodology used in the study. The study adopted a mixed-methods research design where both quantitative and qualitative data were collected and analysed. Quantitative data were collected from household heads, while qualitative data were collected from employees at the Water Services Department of the Harry Gwala District Municipality. Two research instruments were used to collect data, namely, a questionnaire for the household survey and an interview schedule for the employees. These instruments were developed by the researcher and rigorously tested before they were distributed to participants. Quantitative data were analysed using the factor analysis approach, while a manual thematic analysis approach was used to analyse qualitative data. The next chapter discusses quantitative results from the household survey.

CHAPTER 4

QUANTITATIVE RESULTS FROM THE HOUSEHOLD SURVEY

4.1 Introduction

This chapter presents quantitative results from the data collected in the household survey. Following this introduction, the chapter is organised into eight key sections. More precisely, the chapter will present the descriptive statistics of survey respondents, frequency distributions of responses on access to drinking water, reliability of supply, quality of drinking water, and water supply challenges. Subsequently, the chapter presents estimation results from the principal component analysis as well as the Cronbach's alpha reliability test. The final section concludes the chapter.

4.2 Descriptive statistics

A survey was conducted on 412 households, drawn from four local municipalities in the Harry Gwala District Municipality, from August to October 2022. The survey included 132 households in Umzimkhulu Local Municipality, 95 in Ubuhlebezwe Local Municipality, 105 in Dr Nkosazana Dlamini Zuma Local Municipality, and 80 in the Greater Kokstad Local Municipality. The predetermined minimum sufficient sample size for scientifically robust results was 412 households, as discussed in the previous chapter. The 412 responses were collected from the various areas within the Harry Gwala District Municipality, namely, Fairview and Morningview at uBuhlebezwe, Ibisi and Clysdale at Umzimkhulu, Sonyongwana, Ngwagwane, and KwaSpheni at Dr Nkosazana Dlamini Zuma, with Swartberg and Wansburg at Greater Koskstad.

Table 4.1: Summary statistics of the respondents

		Statistic
Household size	Mean	7
	Standard deviation	2
	Minimum	3
	Maximum	26
Age	Mean	40
	Standard deviation	11
	Minimum	25
	Maximum	76
Gender (%)	Male	44
	Female	56
Race (%)	Black	94
	White	2
	Indian/Asian	3
	Coloured	1
Marital status (%)	Single	57
	Married	31
	Other	12
Education level (%)	Primary school	72
	High school	27
	Diploma/Degree	1
Monthly income (%)	< R2 500	36
	R2 501 – R5 000	8
	R5 001 – R10 000	23
	R10 001 – R15 000	29
	>R15 000	4
Source of income (%)	Salary/Wages	54
	Business	2
	Investments	34
	Grant	9

Source: Author's own table

The average household size was seven members, while the average age was 40. More females participated in the survey (56%), while most participants were black (94%), followed by Indian/Asian (3%), whites (2%), and coloureds (1%). These statistics are consistent with the population statistics of Harry Gwala District Municipality, where blacks constitute the majority, followed by whites, Indians, and coloureds. Further, most participants (i.e., 72%) possessed a primary school education, followed by 27% who possessed a secondary school education, with a paltry 1% of the participants possessing either a diploma or a degree.

Each of the primary spatial distributions of the district municipality (i.e., rural areas, townships, low-density suburbs, and informal settlements) was represented in the survey. The majority of respondents (36%) earn salaries below R2500, followed by 29% of participants earning between R10 000 and R15 000, followed by 23% earning between R5000 and less than R10 000. With respect to salaries, the majority of participants receive salaries (54%), followed by 34% who receive investment income, and 9% receive grants.

4.3 Frequency of responses on access to drinking water

Respondents were asked to indicate their sources of drinking water. Furthermore, respondents were also asked to indicate how they accessed drinking water and the travel time they took to access it. Questions investigating the frequency of accessing water through various sources of drinking water were posed to respondents. This supports the second objective of the study. Figure 4.1 shows the frequency distribution of the residents' drinking water sources in the municipality.

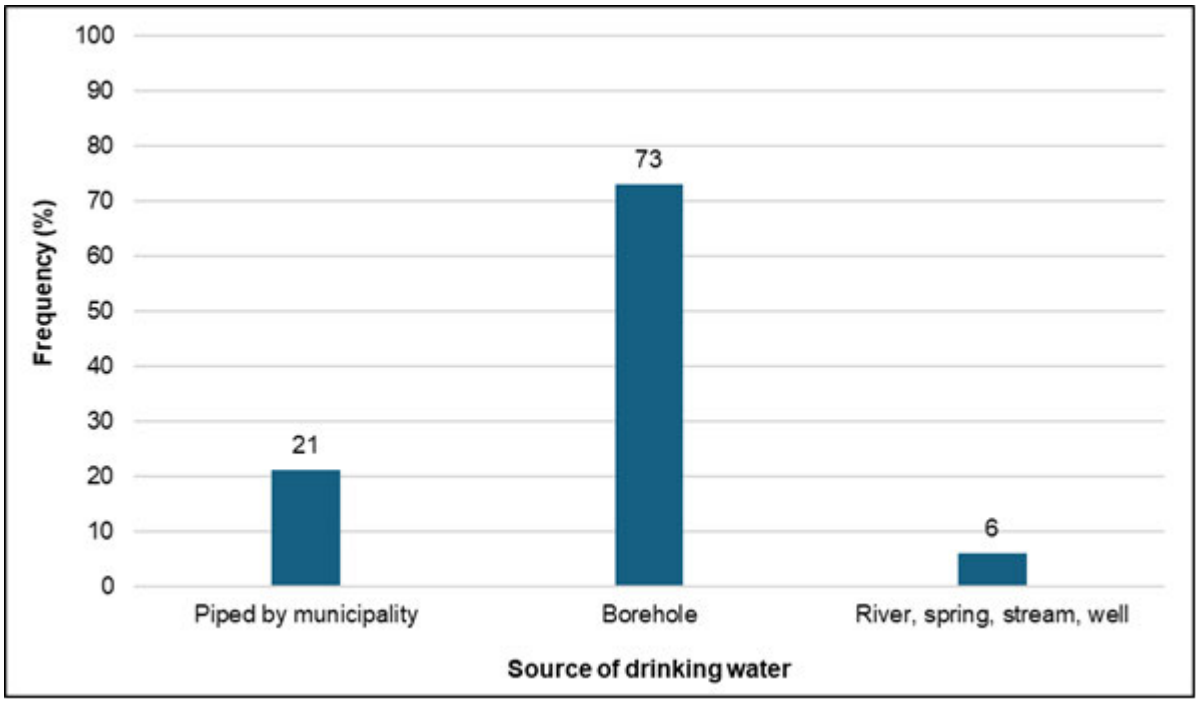

Figure 4.1: Source of drinking water (n = 412)

Source: Author's own diagram

The diagram shows that 73% of respondents indicated that they source their water from the borehole, 21% of respondents indicated that piped water supplied by the municipality is their main source of drinking water, and 6 % of respondents source their water from rivers, streams, and wells. Most respondents, amounting to 73 %, indicated that rivers, springs, and wells are their main sources of water. Thus, most people in Harry Gwala District Municipality are sourcing their water from boreholes, followed by piped water supplied by the municipality.

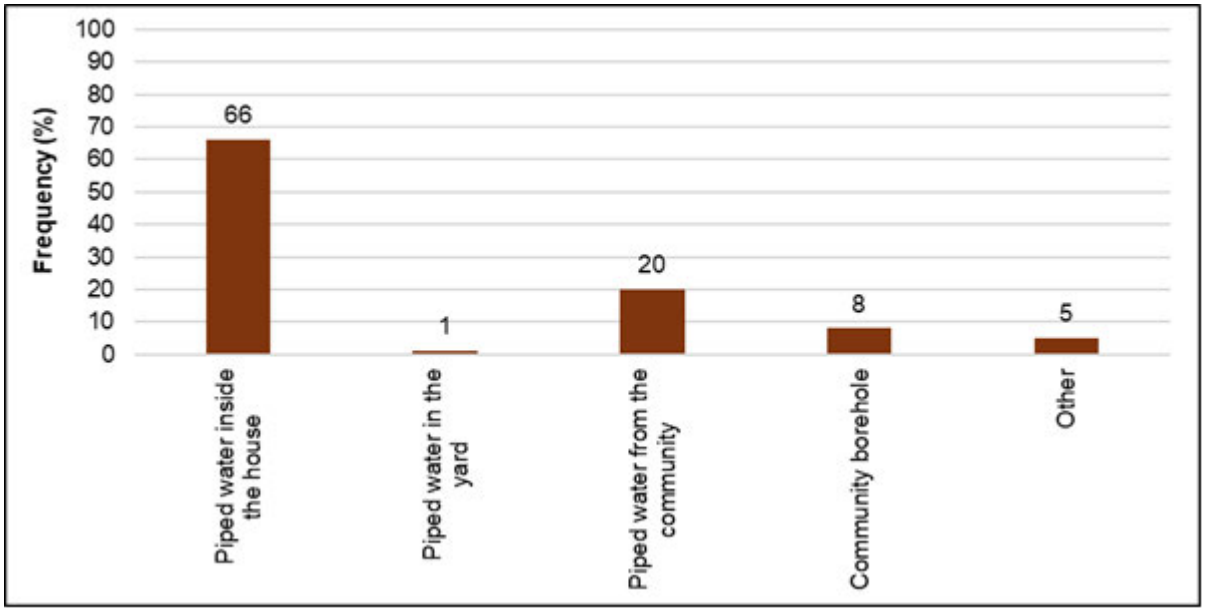

Figure 4.2: Water access point (n = 412)

Source: Author's own diagram

Respondents were asked to indicate their water access points. Figure 4.2 shows that 66% of respondents indicated that they access their water from piped water inside the house, while 1% indicated that they access their water from piped water in the yard. Figure 4.2 also reveals that 20% of respondents access their water through piped water from the community, while 8% indicated that they access their water from the community borehole, and the remaining 5% access their water through other means. This finding can also be compared to the results from respondents probed on the travel time to and from the water source and the time spent waiting in the queue. The results indicate that five minutes emerged as the average travel time to and from the water source, and four minutes were spent by residents waiting in the queue to access water. The consistency and plausibility of the average travel time to and from the water

source and the time spent waiting in the queue versus the waiting time are subject to interpretation.

4.4 Frequency of responses on the reliability of the water supply

Respondents were asked about their views regarding water quality. There are three questions requiring respondents to indicate their frequency of supply interruptions, the practice of being informed about prior information about supply interruptions and being updated during interruptions. Figure 4.3 shows the frequency distributions of responses to the three water reliability questions asked of respondents.

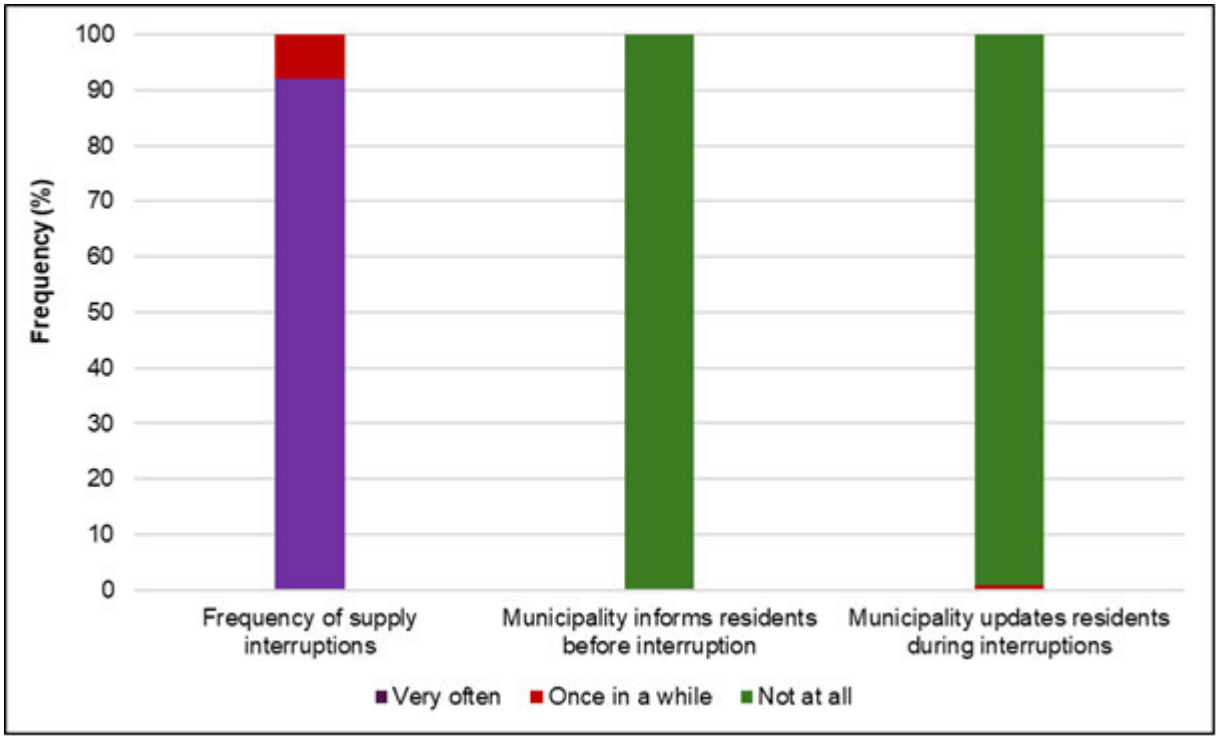

Figure 4.3: Water supply reliability (n = 412)

Source: Author's own diagram

The graph shows that almost 93% of respondents affirmed that they experience water supply interruptions very often, while almost 7% alluded to experiencing water supply interruptions occasionally. This demonstrates the evident lack of reliability in the supply of water to residents in Harry Gwala District Municipality. This finding suggests a lack of reliability in the system negatively impacts the water supply system and might cause

water shortages (Delcore, 2017). The few who affirmed experiencing water supply challenges occasionally might be those who are well placed to have reliable water supply (Poudel and Duex, 2017). Figure 4.3 also shows that an overwhelming majority of residents (100%) indicated that the municipality does not inform them at all about impending water supply interruptions. Almost 99% of respondents indicated that the municipality does not at all update residents during water supply interruptions, while a paltry 1% indicated that they are informed occasionally.

These findings can be compared to findings on the number of times residents stay without water per month and the duration of water supply interruptions. The results indicated that 94% of respondents indicated that they spend about 4 days in a month, while 4% indicated that they spend about 3 days without water. In response to the question on the duration of water supply interruptions, 90% of respondents indicated that water supply interruptions last for a few hours. What stands out from these findings is that most residents in Harry Gwala District Municipality experience frequent water supply interruptions, which is a serious challenge that the municipality needs to address. Also, the results indicate that the municipality does not inform residents about water supply interruptions, which is a challenge facing residents. This points to unprofessional conduct on the part of the municipality and leads to dissatisfaction among residents. The results also demonstrate that the municipality does not largely update residents about impending water supply challenges.

4.5 Frequency of responses on the quality of drinking water

Respondents were asked to indicate the quality of drinking water. There are at most five questions requiring residents' opinions on whether the water they drink is of good quality, whether it has a bad smell, whether it has a colour, has a bad taste, or has dirt particles. Respondents were also asked to indicate whether they engage in the practice of boiling water before drinking. This question was in line with objective number 1 of identifying challenges facing the residents of Harry Gwala District Municipality. Figure 4.4 shows the frequency distribution of responses to water quality questions.

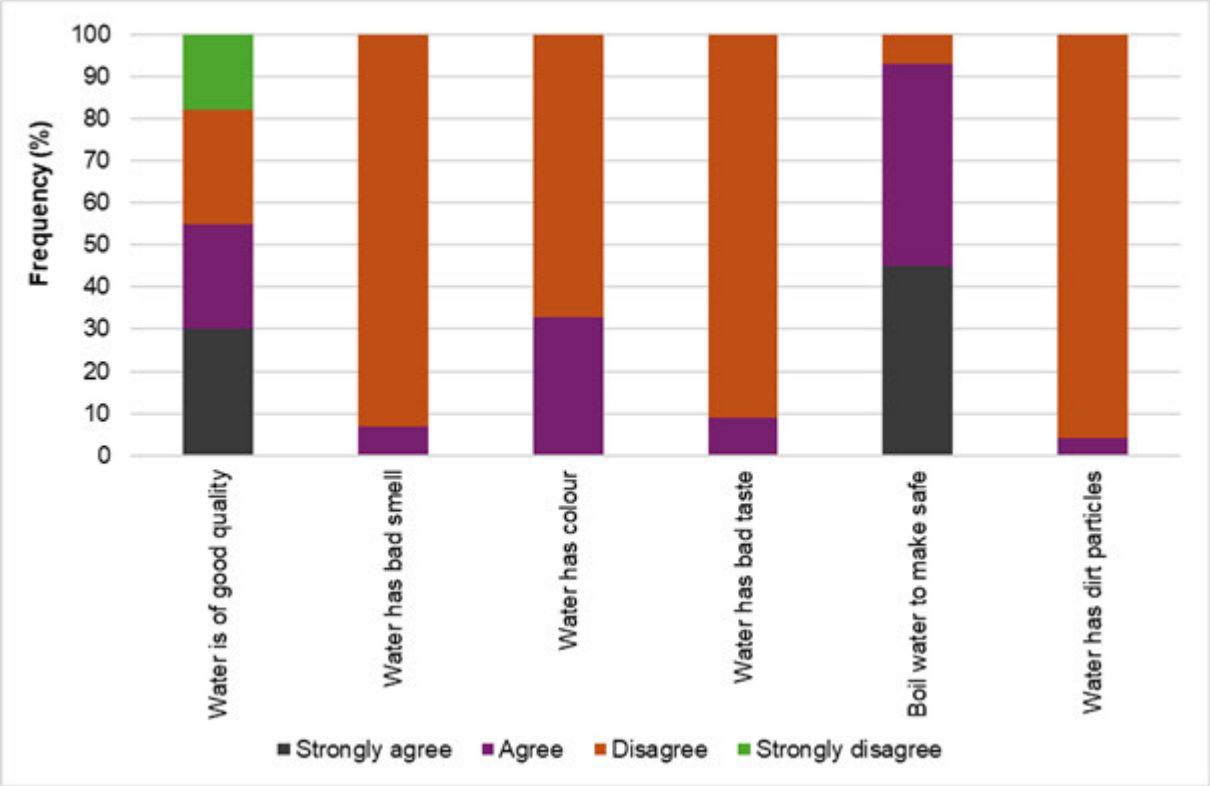

Figure 4.4: Water supply reliability (n = 412)

Source: Author's own diagram

Figure 4.4 demonstrates that 30% strongly agreed, while almost 25% agreed that water is of good quality. This demonstrates that a cumulative majority (55%) of respondents generally agreed that the water they consume is of good quality, while the rest generally disagreed. Though the result shows some improvement in water quality, it is also important to mention that the smaller percentage who disagreed that water is of good quality is instructive to the municipality to make further improvements to the quality of water they provide to the general residents under their jurisdiction.

In terms of the smell of water, 92% of respondents generally disagreed that the water they consume has a bad smell. This points to significant improvements on the part of the municipality in ensuring the provision of quality water that does not smell. A larger percentage of respondents (67%) indicated that the water they drink does not have colour, while 96% indicated that the water does not have dirty particles. This clearly demonstrates further improvements in water quality as far as the absence of water colour and dirt particles is concerned. Coloured water signifies the presence of impurities and poor quality. In this context, the finding is indicative of the fact that a

larger percentage of the people in Harry Gwala district are exposed to water of good quality without impurities; hence, water colour is not a significant challenge affecting water supply in the municipality. Also, most respondents (91%) indicated that the water they drink does not have a bad taste, further indicating water quality improvements. The finding that water from rivers, streams and wells has bad taste supports the views expressed by McKenzie et al. (2013).

4.6 Frequency of responses on the determinants of water supply challenges

It was essential that the supply-side determinants of water supply challenges be determined. This relates to politics, insufficient funds, mismanagement of funds, exclusion of communities, corruption, mismanagement of sewage, existence of old pipes, low water tariffs, poor infrastructure maintenance, municipality delays in solving water problems, and lack of skilled personnel as the supply-side determinants of water supply challenges. Figure 4.5 shows the frequencies of the various supply-side determinants of water supply challenges.

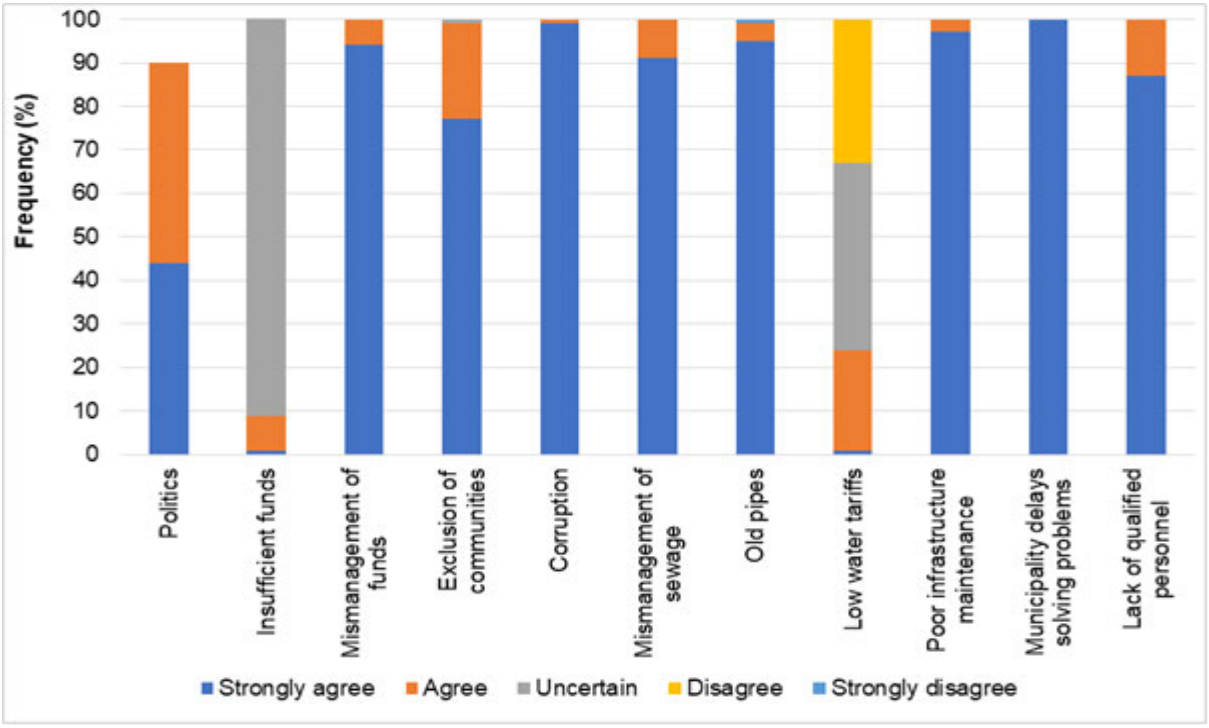

Figure 4.5: Supply-side determinants of water challenges (n = 412)

Source: Author's own diagram

The diagram shows that 46% of the sampled respondents were of the view that politics (political interference) is one of the determinants or drivers of the water supply challenges faced by Harry Gwala District Municipality. Politicians often urge citizens to defy payment of rates and to resist municipal policies on many matters, including payment for water supply, hence crippling the municipality's ability to supply adequate water (Kazman, 2014). An overwhelming majority (92%) of respondents were grossly uncertain whether the water supply challenges faced by the municipality were due to a lack of sufficient funds. Most municipalities are underfunded and are also facing challenges in collecting revenues from their residents, owing in part to poor debt collection strategies, resistance from community members, interference by politicians, economic hardships, and many other factors leading to failure to adequately supply water (McPhail et al., 2014; Nkabane and Nzimakwe, 2018). This might indicate a lack of transparency on the part of municipal leadership regarding the state of finances facing the municipality.

However, most respondents (92%) were in strong agreement that mismanagement of funds and an overwhelming majority (99%) were also in strong agreement that corruption is among some of the determinants of water supply side challenges facing the municipality. This finding indicates a pervasive perception among the residents of the municipality that mismanagement of public funds and corruption are among the key factors behind the water supply challenges facing the municipality. Corruption and mismanagement of funds at the upper levels of the water supply chain, particularly at the leadership and managerial levels, cripple the water distribution sector (Nkabane and Nzimakwe, 2018). Figure 4.5 illustrates that 91% of respondents consider mismanagement of sewage supply-side determinants of water supply challenges facing Harry Gwala District Municipality. This finding implies that sewage is being discharged into water supply sources without any effective intervention from the municipality (Baietti and Curiel, 2017; Ramphele, 2014; van Rensburg et al., 2016).

Also, 95% of respondents attributed water supply challenges to the existence of old pipes, while 97% cited poor infrastructure maintenance as another key water supply side challenge affecting the municipality. Both findings illustrate that aged infrastructure in the form of water, coupled with poor infrastructure maintenance, is causing water supply challenges within the municipality. Most South African

municipalities face serious backlogs in key infrastructure maintenance and rehabilitation, resulting in substantial water losses (Muyunda, 2017; Nkuna, Mothetha and Mema, 2014). The finding implies that there is a lack of urgency by municipalities in most developing countries to invest in the refurbishment of existing water supply and distribution systems (Dos Santos et al., 2017; Hellandendu, 2017).

Figure 4.5 also shows that the municipality management is viewed by 100% of respondents as failing to solve water problems facing the residents in a timely manner. This also implies that when water infrastructure and equipment break down, municipalities take a considerable amount of time to rectify the problems because they lack the requisite expertise in their maintenance departments (Moyo, 2013). This finding is also consistent with 87% of respondents' illustration that the municipality lacks adequately skilled manpower to perform their jobs in the water department diligently. The scarcity of proficient workers in the water cleansing, chemical, and mechanical engineering sectors is persistent in most South African municipalities, resulting in inadequate oversight of water quality (Bessong et al., 2014; Jachimowski, 2017; Oakland et al., 2012; Wilmot, 2014). Most importantly, demand-side challenges affect water supply in HGDM. Figure 4.6 shows the results pertaining to the contributions of illegal connections, industries, pipe theft, non-payment for services, poverty, and disinterested communities as the demand-side determinants of water supply challenges. Figure 4.6 shows the results of the demand-side determinants of water supply challenges.

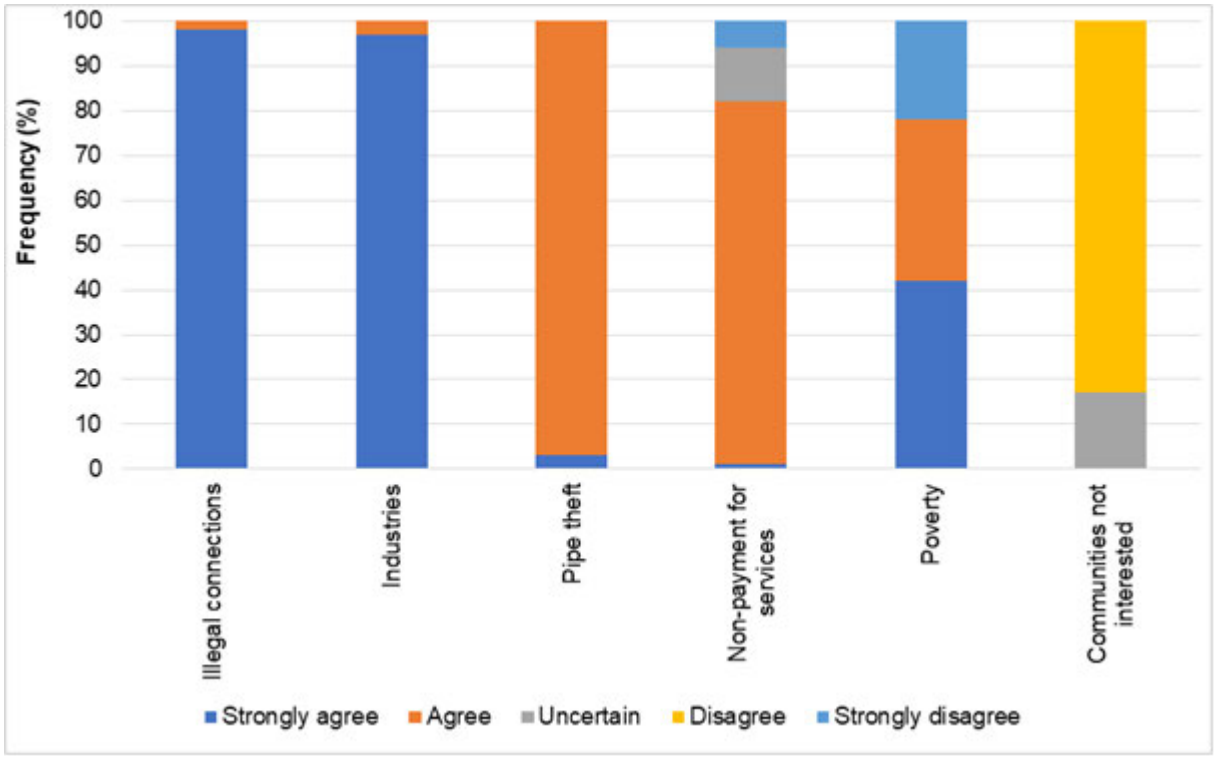

Figure 4.6: Demand-side determinants of water challenges (n = 412)

Source: Author's own diagram

Figure 4.6 shows that the majority (98%) of respondents strongly agreed that illegal connections are a challenge facing the municipality. The finding indicates that most of the sampled respondents were of the conviction that industries are causing the water supply challenges affecting the municipality. Gumbi and Rangongo (2015) also acknowledged that river and stream water whose sources emanate from industrial and residential areas smell because sewage treatment is perceived by some decision-makers as a low priority. This finding may be plausible given that industries in South Africa have been criticised for discharging their waste into water sources (Gibson et al., 2014; Gumbi and Rangongo, 2015; Rossouw and Görgens, 2015).

Pipe theft also emerged as one of the challenges affecting water supply in HGDM. This is evidenced by the fact that 97% affirmed that the theft of water pipes is among the challenges that have affected the municipality's capacity to supply water to its residents. A significant 87% of the sampled population also agreed that non-payment of services provided by the municipality is a challenge contributing to poor water supply. The percentage of sampled respondents (42%) does not show an overwhelming agreement that poverty is affecting water supply in HGDM. When

compared to the percentage of respondents who affirmed the non-payment of services, it does appear that poverty might also be contributing to this non-payment of services.

Therefore, this discovery implies that the often-mentioned justification of poverty as the reason for not being able to afford rates is not always valid, since non-payment occurs in both impoverished and non-impoverished regions (Fjeldstad, 2016). Sabotaging public services is evident in the growing proportion of debt impairment due to non-payment, as the amounts owed to municipalities have ballooned exponentially over the years, crippling municipalities' abilities to adequately supply water (Kruger, 2018). Such huge debt and high debt impairments cripple the ability of municipalities to meet their obligation to provide public services.

4.7 Estimation of determinants using the principal component factor

The study aimed to establish the key determinants of water supply challenges in HGDM. Using an extensive literature review, discussions with experts, and some focus group discussions prior to data collection, seventeen factors emerged as possible determinants of the water supply challenges currently experienced in the municipality. These possible determinants can be grouped into supply-side factors and demand-side factors. The former includes factors that can be blamed on the municipality as the sole supplier of water services in the municipality, while the latter refers to the activities of water consumers. More precisely, eleven supply-side factors and six demand-side factors were identified. Factors falling into each of these categories were discussed in the previous section.

It is important to note that seventeen questions were asked to 412 heads of households across the municipality, and each question was coded on a five-point scale (i.e., 1 = strongly agree, 2 = agree, 3 = uncertain, 4 = disagree, and 5 = strongly disagree). While the previous section presented the frequency distribution of the responses to the seventeen questions, it is important to understand that frequency distributions provide a basic understanding of how respondents answered the questions. Generally, frequency distribution statistics provide some generic and basic understanding of phenomena (Fisher and Marshall, 2009; Marshall and Jonker, 2010;

Mishra et al., 2019). Thus, statistical modelling is required to understand the scientific impact of each of the selected possible determinants. Factor analysis is frequently employed in the econometric literature to authenticate a set of questions that first seem to have significance (Hashmi et al., 2020; Mahadea and Kabange, 2019; Taherdoost et al., 2022).

Against this backdrop, a principal component factor (PCF) model, which falls under the group of factor analysis models, was used to establish the key determinants of water supply challenges in the HGDM. Unlike other factor analysis techniques, PCF treats all communalities as 1, implying that there are no unique factors in the model (Huang et al., 2019; Schreiber, 2021). It generates eigenvalues, and the decision rule for selecting factors is to retain those with eigenvalues greater than 1. Additionally, PCF indicates the proportion of variance explained by each factor and the cumulative variance explained by successive factors. The PCF model can be performed either with unrotated or rotated components. While both approaches are useful, if components are not rotated, the effect of the principal component analysis method will be diminished. This would then imply that additional components must be chosen to explain the variance in the data (Nurimbetov et al., 2022; Valsalan et al., 2020). This study estimates the determinants of water supply challenges using an unrotated PCF model. Table 4.2 presents the estimation results.

Table 4.2: Estimation results from an unrotated PCF model

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor 1	2.399	0.795	0.150	0.150
Factor 2	1.604	0.101	0.100	0.250
Factor 3	1.502	0.195	0.094	0.344
Factor 4	1.307	0.068	0.082	0.426
Factor 5	1.239	0.170	0.077	0.503
Factor 6	1.069	0.045	0.067	0.570
Factor 7	1.024	0.040	0.064	0.634
Factor 8	0.984	0.076	0.062	0.695
Factor 9	0.908	0.063	0.057	0.752
Factor 10	0.845	0.131	0.053	0.805
Factor 11	0.714	0.074	0.045	0.850
Factor 12	0.640	0.064	0.040	0.890
Factor 13	0.576	0.102	0.036	0.926
Factor 14	0.474	0.052	0.030	0.955
Factor 15	0.422	0.129	0.026	0.982
Factor 16	0.294		0.018	1.000
Observations (N)	*409*			
Retained factors	*7*			
Parameters	*91*			
Chi^2	*855.12*			
Prob > Chi^2	*0.000*			

Source: Author's own table

Since only factors with eigenvalues that are greater than one (> 1) are retained, the results indicate that the PCF model identified seven factors that should be retained. These factors had eigenvalues that ranged from 1.024 to 2.399 and contributed 63.4% of the variance observed in the data. This is a significant variance, which improves the reliability of the results. While Table 4.2 provides the number of eigenvalues that should be retained and their contribution to the variance observed in the data, the second part of the PCF model is factor loadings. This shows the real variables from the list that load into each of the seven identified factors. In doing this, each factor is then identified based on the similarity of the variables loading into it. Table 4.3 shows the factor loadings for the seven retained factors. The table removes any coefficient whose absolute value is less than 0.3.

Table 4. 3: Factor loading results

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Uniqueness
Politics			0.519	-0.433	-0.410			0.246
Illegal connections		-0.313					0.403	0.283
Insufficient funds	-0.700	0.501						0.196
Mismanagement	0.593							0.503
Exclude community	0.525	0.383						0.454
Corruption							-0.610	0.577
Industries					-0.391	0.508		0.441
Sewage management			0.715		0.340			0.288
Old pipes			0.508		0.523			0.285
Pipe theft		-0.600		-0.386				0.274
Low tariffs	-0.483		-0.348		0.520			0.269
Non-payment	0.365	0.354				0.386		0.509
Poverty	0.487	0.430						0.394
Maintenance			0.301			-0.432	0.422	0.478
Qualified personnel		0.510		0.533				0.347
No interest	-0.588			0.336	-0.348			0.315

Note: Blanks indicate abs (loading) < .3

Source: Author's own table

Table 4.3 provides valuable insights into the underlying structure of the data. Each factor represents a cluster of variables that are interrelated, highlighting the main dimensions affecting water supply issues in the district. Factor 1 has high negative loadings for "insufficient funds" (-0.6999), "mismanagement" (0.593), and "pipe theft" (-0.5997). This factor indicates that financial constraints and mismanagement are closely linked and negatively impact the water supply. The strong loadings suggest that improving financial management and reducing pipe theft could significantly enhance the water supply situation. The high uniqueness value for "insufficient funds" (0.1961) indicates that this variable is particularly distinct in contributing to this factor.

Factor 2 is characterised by high loadings for "exclude community" (0.525), "non-payment" (0.3537), and "poverty" (0.4303). This suggests a dimension where community exclusion and socio-economic issues like poverty and non-payment are intertwined. These variables indicate that social inclusion and addressing poverty are critical for improving the reliability of the water supply. The unique contribution of "exclude community" (0.4535) highlights its specific impact within this factor. Factor 3 shows significant loadings for "politics" (0.5192), "old pipes" (0.5082), and "qualified personnel" (0.5331). This factor emphasises the role of political factors, ageing infrastructure, and the need for qualified personnel in maintaining the water supply system. The high loading for "qualified personnel" (0.5331) underscores the importance of skilled labour in managing and upgrading the water infrastructure. Factor 4 is primarily influenced by "politics" (-0.4325) and "exclude community" (0.3827), suggesting that political factors and community exclusion are significant issues. This factor implies that corruption and political interference may exacerbate problems related to community exclusion, affecting overall water supply reliability. Factor 5 includes high loadings for "low tariffs" (-0.3479) and "no interest" (-0.3475). This factor indicates that socio-economic policies, such as tariff structures and public interest, play crucial roles in water supply issues. The loadings indicate that adjusting tariff policies and increasing public engagement could help address water supply challenges.

Factor 6 is characterised by "sewage management" (0.7153) and "industries" (0.5082). This factor highlights the significant impact of sewage management and industrial activities on water supply. Proper sewage management and regulation of

industrial water use are essential to ensuring a reliable water supply. Factor 7 has a high loading for "corruption" (-0.6104) and "non-payment" (0.3862). This factor underscores the detrimental effects of corruption and non-payment on the water supply system. Addressing these issues is critical for improving water supply reliability. The factor loadings reveal distinct dimensions impacting water supply in the Harry Gwala District Municipality. Financial management, community inclusion, infrastructure maintenance, socio-economic policies, and anti-corruption measures are pivotal areas that need attention. By focusing on these factors, policymakers can develop targeted interventions to enhance water supply reliability and address the underlying issues effectively.

It is common practice in the econometric and statistical literature to confirm the adequacy of the PCF model as an estimation tool. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, developed by Kaiser (1974), is a common test for the applicability of the PCF model given a dataset. The KMO sample sufficiency test assesses the suitability of the correlations and partial correlations among the variables used in the investigation. In general, when the partial correlations are greater than the correlations, the KMO measure is tiny, indicating that it is not feasible to describe the data in a low-dimensional form (Kaiser, 1974). The KMO score ranges from 0 to 1, where 0 indicates unacceptable sample adequacy for adopting the PCF model and 1 means exceptionally acceptable. The decision rule is to adopt the PCF model if the KMO score is 0.5 and above (i.e., KMO > 0.5). Table 4.4 shows the KMO sampling adequacy test results.

Table 4.4: Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy

	KMO
Politics	0.454
Illegal connections	0.380
Insufficient funds	0.523
Mismanagement	0.629
Exclude community	0.724
Corruption	0.391
Industries	0.646
Sewage management	0.468
Old pipes	0.508
Pipe theft	0.471
Low tariffs	0.512
Non-payment	0.622
Poverty	0.577
Maintenance	0.434
Qualified personnel	0.434
Community interest	0.593
Overall	**0.534**

Source: Author's own table

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy presented in Table 4.4 is a crucial statistic in determining the suitability of data for factor analysis. It evaluates the proportion of variance among variables that might be attributed to underlying common factors. The KMO statistic ranges from 0 to 1, where higher values indicate greater suitability for factor analysis. Typically, KMO values above 0.6 are deemed acceptable, those between 0.5 and 0.6 are considered mediocre, and values below 0.5 suggest that the data may not be suitable for factor analysis. Examining the KMO values for the individual variables in the dataset from HGDM in KwaZulu-Natal reveals a spectrum of sampling adequacy. The variable "exclude community" has the highest KMO value of 0.724, indicating a substantial amount of common variance shared with other variables. This suggests that "exclude community" is highly suitable for factor analysis. "Mismanagement" and "industries" have KMO values of 0.629 and 0.646, respectively. These values are considered adequate, implying that these variables are also appropriate for inclusion in factor analysis.

"Non-payment" and "community interest" have KMO values of 0.622 and 0.593, respectively. Although these values are marginally acceptable, they indicate that these variables may have enough common variance with others to justify factor analysis, albeit on the borderline. Variables such as "insufficient funds," "old pipes," and "low tariffs," with KMO values of 0.523, 0.508, and 0.512, respectively, exhibit mediocre adequacy. These values suggest that there is some degree of shared variance, but it is not particularly strong. These variables might be retained in the analysis, but with caution. On the other hand, variables like "politics," "illegal connections," "corruption," "sewage management," "pipe theft," "maintenance," and "qualified personnel", which have KMO values ranging from 0.380 to 0.471, show low sampling adequacy. This indicates that they share little common variance with the other variables in the dataset and may not contribute meaningfully to factor analysis.

The overall KMO value for the dataset is 0.534, which is mediocre. This indicates that while there is some shared variance among the variables, it is not particularly strong. The data is on the borderline of being appropriate for factor analysis. Given this overall value, the results of a factor analysis might be somewhat unstable or less reliable. It may be prudent to either collect more data or reconsider the selection of variables included in the analysis. Given the overall KMO value of 0.534, proceeding with factor analysis is possible but should be approached with caution. The mediocre KMO value suggests that the factor analysis might not yield very clear or strong factors, and the resulting factors may not explain a large portion of the variance. For variables with very low KMO values (below 0.5), it might be beneficial to consider removing them from the analysis to see if the overall KMO value improves. This process can help in identifying and excluding variables that do not share enough common variance with others, thereby enhancing the quality and reliability of the factor analysis.

In the context of this study, an overall KMO score of 0.534 was obtained. While a higher KMO score would have been more acceptable, the overall score reported in this study generally suggests that the PCF model is an acceptable tool for estimating the determinants of water supply challenges in the sample. While the overall score gives a clear indication of the overall adequacy of the model, it is always important to also report on the KMO scores reported for each variable. In the context of this study, the KMO scores for the sixteen variables analysed ranged from 0.4 to 0.7, and they

were generally acceptable. The complete list of the KMO scores obtained in this study is given in Table 4.4.

Generally, after estimating a PCF model, it is standard practice to present a scree plot of the eigenvalues. The scree plot helps to determine the number of factors (also called components) that should be kept. The number of factors to keep as key determinants is usually difficult to determine in factor analysis (Afifi et al., 2012; Hamilton, 2013). Typically, statistical literature suggests selecting a variance percentage of 90% and retaining the minimum number of components necessary to explain at least that much of the variation (Mahadea and Kabange, 2019). The computed eigenvalues indicate the extent to which they explain the variation. Cattell (1966) introduced the concept of a scree plot as a valuable tool for visually representing the relative magnitudes of eigenvalues. Through performing this task, researchers may determine the optimal number of constituents to maintain. A scree plot was computed in this study, and the results are presented in Figure 4.7.

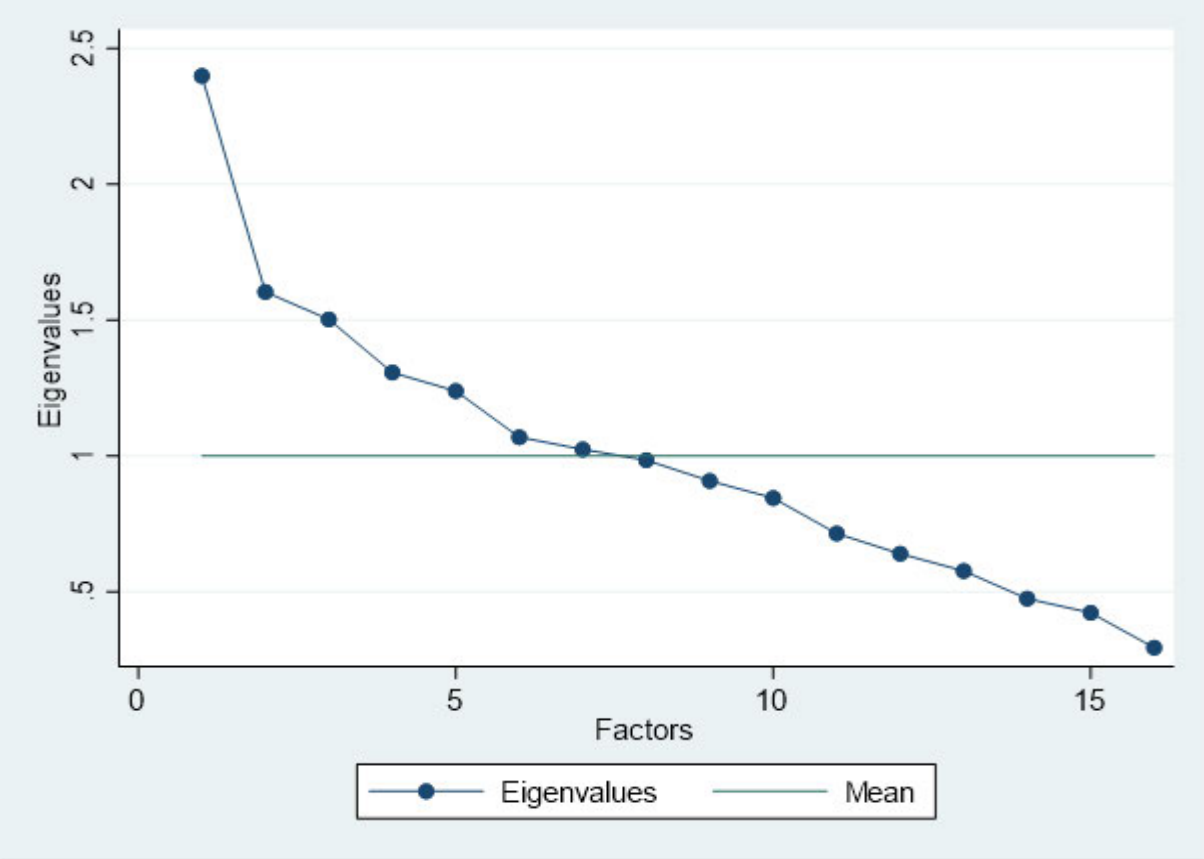

Figure 4.7: Scree plot of eigenvalues after PCF estimation

Source: Author's own diagram

The scree plot in Figure 4.7 analyses a correlation matrix, so the mean eigenvalue is 1. The general rule is to retain the components associated with the higher part of the scree plot and drop the components associated with the lower part of the scree plot (Cattell, 1966). The boundary between high and low is not always clear here, but it is recommended to choose seven components above the mean eigenvalue of 1. This is consistent with the results presented in Table 4.2, where the unrotated and PCF models selected seven factors as key determinants of water service delivery challenges.

4.8 Cronbach's alpha test for reliability

To ensure accuracy, it is crucial to calculate the interitem correlations or covariances between all pairs of variables utilised in the research, as required in both the PCF model and the IPF model. The Cronbach's alpha test, invented by Cronbach in 1951, is used to evaluate the reliability of a summative rating scale, known as the Likert scale, which includes specific variables or items. A collection of things is sometimes referred to as a test or battery, whereas a scale is only the sum of the scores assigned to each individual item. In statistical analysis, scales are created by using either the raw item scores or the standardised item ratings. The Cronbach's alpha test calculates the cumulative scale from the provided elements (variables) and automatically reverses the direction of any when needed. The alpha score ranges from 0 to 1, with 0 indicating no correlation and 1 signifying extreme correlation. The literature generally suggests that a score that is greater than or equal to 0.7 shows strong correlation and is desirable (Devi, 2017; Humphries, 2017; Weber, 2017). However, scores around 0.5 can be accepted, even though they show relatively weaker correlations. Thus, scores below 0.5 should not be accepted, as they show extremely weak covariances between the selected variables. Table 4.5 presents the Cronbach's alpha test results.

Table 4.5: Cronbach's alpha test results for interitem correlations

	N	Sign	Item-test correlation	Item-rest correlation	Average interitem correlation	Alpha
Politics	411	+	0.310	0.136	0.065	0.511
Illegal connections	412	-	0.310	0.136	0.065	0.511
Insufficient funds	412	+	0.590	0.454	0.050	0.442
Mismanagement	412	-	0.490	0.335	0.056	0.468
Exclude community	412	-	0.478	0.322	0.056	0.471
Corruption	412	+	0.195	0.016	0.071	0.535
Industries	410	-	0.304	0.130	0.065	0.512
Sewage management	412	+	0.127	-0.053	0.075	0.548
Old pipes	412	-	0.215	0.036	0.070	0.531
Pipe theft	412	+	0.390	0.223	0.061	0.492
Low tariffs	412	+	0.419	0.255	0.059	0.486
Non-payment	412	-	0.391	0.224	0.061	0.492
Poverty	412	-	0.454	0.294	0.057	0.477
Maintenance	412	-	0.200	0.021	0.071	0.534
Qualified personnel	412	-	0.220	0.042	0.070	0.530
Community interest	412	+	0.488	0.333	0.056	0.469
Test scale					**0.063**	**0.518**

Source: Author's own table

The *test scale* corresponds to the additive scale, where 0.063 is the average interitem correlation and 0.518 is the alpha coefficient for a test scale based on all items. *N* is the number of non-missing values of the items, while *Sign* shows the direction in which an item variable entered the scale, where a negative sign (-) indicates that the item was reversed. The remaining four columns in Table 4.5 give information on the effect of one item on the scale. Item-test correlations should almost be the same for all items and may not be adequate to detect items that fit poorly because the poorly fitting items may distort the scale (Considine, Botti, and Thomas, 2005). Thus, it is advisable to consider item-rest correlations, which signify the correlation between an item and the scale that is formed by all other items. The last column gives Cronbach's alpha for the test scale, which consists of all but one item. Given the overall Cronbach's alpha of 0.518, some items do not fit well on the scale in all respects. The item-test and item-rest correlations of most items are much lower than those reported for each item under the last column. Overall, a Cronbach's alpha of 0.518 reported in the study shows

reasonable interitem correlations, which signifies the reliability of a summative Likert rating scale for the variables specified in the study.

4.9 Conclusion

This chapter presented the quantitative results pertaining to the water supply challenges and determinants of water supply challenges facing the HGDM. Both descriptive and inferential statistics were presented. Illustrations in the form of bar graphs, tables and scree plots were used to present the findings. Inferential statistics for the determinants of water service challenges were estimated using the principal-component factor model, and the results were discussed. The next chapter discusses the qualitative results from municipal employees.

CHAPTER 5

QUALITATIVE RESULTS FROM MUNICIPAL EMPLOYEES

5.1 Introduction

The study's qualitative elements aimed to achieve three fundamental objectives: identifying water supply challenges, drivers of water scarcity, and municipality responses to address the challenges. Qualitative data were gathered using in-depth interviews. The perspectives, views, and experiences of participants are expressed and presented in this chapter. The chapter is formulated in four sections. The demographic profiles of the participants constitute the first section. The chapter then presents the challenges in water supply, explores the drivers of water scarcity, and discusses the municipality's response to these issues. The chapter concludes with a summary.

5.2 Demographic profiles of the participants

Demographic data serves as a foundation for comprehending the attributes of individuals. The data encompasses several demographic factors, such as race, gender, marital status, occupation, age, and level of education (Kumar, 2019). The research focused on demographic factors, including gender, work position, and degree of education, since these were considered significant for understanding the opinions of the participants. Aliases were used to safeguard the anonymity of the participants. Their actual names were substituted with numerical identifiers. Pseudonyms are used to safeguard participants from potential victimisation or legal action (Saunders et al., 2016). Thus, numbers (1–15) were used to identify participants in this study. Table 5.1 presents the demographic profiles of the employees who participated.

Table 5.1: Demographic profiles of participants

Participant	Gender	Position	Municipal experience	Departmental experience	Age	Education level
1	Male	Manager	12	15	49	Degree
2	Male	Manager	8	13	42	Postgraduate
3	Female	Manager	5	5	38	Diploma
4	Male	Technician	9	3	49	B.Tech
5	Female	Technician	6	6	38	Diploma
6	Male	Technician	2	2	26	B.Tech
7	Female	Fieldworker	15	9	45	Certificate
8	Male	Fieldworker	3	3	25	Diploma
9	Male	Fieldworker	10	7	51	Degree
10	Female	Fieldworker	2	2	35	Diploma
11	Male	Fieldworker	7	7	40	Diploma
12	Male	Fieldworker	3	3	39	Diploma
13	Male	Fieldworker	9	8	47	Diploma
14	Male	Fieldworker	4	4	31	Diploma
15	Male	Fieldworker	6	5	29	Diploma

Source: Author's own table

Table 5.1 shows that an equal number of participants possess either a diploma or a degree, except for one who possesses a postgraduate degree in academic qualifications. Overall, the participants have been working in the municipality for a very long time. The combined experience of all participants in the municipality is 101 years, with an average of 6.7 years. The participant with the shortest tenure in the municipality served for two years, while the participant with the longest tenure served for 15 years. However, participants' average tenure in the Water Department is slightly shorter (6.13 years) than their overall tenure in the municipality. This indicates that some participants served in other municipal departments before joining the Water Department. This indicates that some participants served in other municipal departments before joining the Water Department.

The fact that most participants have many years of experience in the water department implies that they have much more detailed insights regarding the challenges facing the Harry Gwala District Municipality (HGDM). The average age was 40 years, with the youngest participant being 25 years old, while the eldest was 51 years old.

Participants occupied various portfolios in the Water Department, which contributed to improving the quality of the data collected. Responses were received from managers, technicians and fieldworkers. The diversity in positions, age, education, and experience means that data containing different views on water service delivery challenges may be obtained.

5.3 Water supply challenges, drivers, and responses in the municipality

This section focuses on water supply challenges in HGDM. It also illustrates the drivers of water challenges and the responses initiated by the municipality to solve water supply challenges. This is derived from the study objectives. As highlighted in the previous chapter, the thematic approach is used to analyse qualitative data collected from employees. In this regard, each objective is used to represent a different theme of the study. Subthemes (i.e., core ideas under each theme) are then used to explain each theme further. Table 5.2 shows themes generated from the qualitative data.

Table 5.2: Water supply challenges, drivers and responses

Theme	Sub-theme	Frequency
1. Water supply challenges	a) Inadequate Financial Resources	3
	b) Aged water infrastructure	3
	c) Demand exceeding supply capacity	4
	d) High cost of water treatment	2
	e) Political interference and corruption	3
	f) Adverse weather conditions	3
2. Drivers of water supply challenges	a) Unsustainable lower revenue base	3
	b) Sub-economic tariffs	4
	c) High levels of population growth	4
	d) Discharge of waste into water sources	3
	e) Climate change	3
3. Municipal responses to challenges	a) Education and awareness	3
	b) Water disconnections to defaulters	3
	c) Financial mobilisation	3
	d) Budgetary reprioritisation for infrastructure	2

Source: Author's own table

5.3.1 Water supply challenges

This theme is linked to the first objective of the study, which sought to investigate water supply challenges affecting HGDM. Participants were asked to express their thoughts on water supply challenges. Six subthemes emerged under this theme: inadequate financial resources, aged water infrastructure, demand exceeding water supply capacity, high cost of water treatment, political interference and corruption, and finally adverse weather conditions.

5.3.1.1 Inadequate financial resources

Financial challenges emerged as a prominent theme describing the water supply challenges being faced by the HGDM water department. Most participants pointed out that HGDM's water services were unable to provide quality water services due to financial constraints. Participants pointed out that *"… the most pressing challenge at our municipality is financial, our water services department is not getting enough funding as much as we need to do a good job of delivering the right quantity and quality of water to our residents. Financial challenges explain the rot you see in the department, as you might know that we have ageing municipal infrastructure we are failing to replace and repair because of financial challenges, so water leakages are common, and water losses are resulting in quite a number of households being deprived of water…"*

Based on the findings presented, the most pressing challenge faced by the municipality is a lack of adequate financial resources for the water services department. This financial constraint is hampering the department's ability to deliver sufficient quantity and quality of water to residents effectively. The primary reasons for the financial challenges include insufficient funding allocation, ageing municipal water infrastructure that requires replacement and repair, prevalent water leakages leading to water losses, and a significant portion of the population being unable to pay for water services due to defaulting on payments or being classified as indigent. "… *to be honest we are experiencing lots of challenges like failure to improve and expand our water supply services to the population mainly due to constrained fiscal space, that is our department is not adequately funded to the level that we would want, even the*

revenue we receive from rate paying residents is not enough to plough back into providing world class water services, why because some eligible residents are defaulting on payments, and we also have a high number of indigent population and all this is compounding our financial problems tom the extent that our water service delivery is far from satisfactory because we can't afford to attend to repairing ageing water supply infrastructure nor to expand water supply services to as many residents as we are obliged to supply water".

Inadequate financial resources have resulted in the municipality's inability to improve and expand water supply services to meet the growing population's demands. Despite having elaborate plans to address these challenges, the constrained fiscal space has hindered the department's progress, leaving some residents with no choice but to rely on unsafe water sources such as rivers and streams. Furthermore, the lack of funds has prevented the municipality from building additional water supply capacity, leading to situations where residents must travel long distances to access the nearest water point.

The municipality's water services department is grappling with severe financial constraints, which have significantly impacted its ability to provide reliable and accessible water supply services to all residents. Addressing this financial challenge is crucial for the department to improve its water service delivery and ensure that all residents have access to a safe and adequate water supply. Thus, the municipality is no longer able to address all of the residents' water supply grievances on time and to provide permanent solutions to water supply challenges due to financial challenges (Nkabane and Nzimakwe, 2018; Chepyegon and Kamiya, 2018). Financial challenges have incapacitated the municipality from building more supply capacity to reach all its residents in the various parts of the district. This explains why some of the municipality's residents continue to drink water from rivers and streams, which is unhealthy in modern times, and why some people still travel long distances to reach the nearest water point (Dos Santos et al., 2017).

5.3.1.2 Aged water infrastructure

Quite a number of participants alluded to the fact that aged and dilapidated water supply equipment and infrastructure were constraining the municipality's ability to supply reliable, clean drinking water. HGDM is said to be using old, dilapidated equipment that breaks down constantly, resulting in failure to provide reliable water to residents. The old water supply equipment and infrastructure are causing widespread leakages and losses, depriving many households of a reliable water supply. One of the participants stated that *"another challenge is that we are experiencing a lot of breakdowns in our water supply equipment, mainly because most of our equipment is very old and some of it dates back to the pre-apartheid years, so as technicians we are always running up and down to do maintenance work, and in some cases, we are so overwhelmed because we are very few in the department".*

Participants highlighted the frequent breakdowns with the water supply equipment as a major challenge, largely attributed to the ageing infrastructure. A significant portion of the equipment dates to the pre-apartheid era, making it outdated and prone to failure. This situation has overwhelmed a few technicians in the department, as they are constantly occupied with maintenance work to address the breakdowns resulting in substantial treated water losses through these leakages. Consequently, a portion of the treated water never reaches its intended destination, adversely affecting the availability of the water supply to households.

The problem of burst and leaking pipes is particularly severe in high-density urban residential areas and certain parts of Ixopo's central business district. In some cases, the municipality has experienced delays in repairing these burst pipes due to the advanced age and deterioration of the infrastructure, which includes long stretches of rusty iron pipes. To mitigate the issue of water losses through leakages, the municipality has resorted to replacing the old iron pipes with more durable polythene plastic pipes. However, this process is likely to be time-consuming and resource-intensive, considering the extensive network of aged infrastructure that needs to be replaced.

In summary, the challenges revolve around frequent breakdowns of outdated water supply equipment, burst and leaking aged water pipes leading to substantial water

losses, and the municipality's struggle to promptly address these issues due to the scale of the problem and limited resources. Poudel and Duex (2017) and D'Elcore et al. (2017) also highlighted the same view that common challenges affecting municipalities include inadequate water supply due to leakages from dilapidated infrastructure leading to poor access to water services and loss of revenues.

5.3.1.3 The effect of demand exceeding supply

Excess demand for water outstripping supply came into the spotlight during the interviews. Participants stated that the high demand for clean drinking water against a lower supply capacity was contributing to the water supply challenges facing HGDM. The participants highlighted that a major challenge faced by the municipality in providing an adequate clean water supply is the inability to meet the rapidly increasing demand driven by the high influx of migrants into urban areas and the sprouting of new unplanned settlements. This population growth has outpaced the municipality's water supply capacity, leading to an overstretched system and supply bottlenecks. Additionally, the participants emphasise that the municipality lacks sufficient water supply infrastructure, such as dams and boreholes, to cater to the large areas under its jurisdiction. Consequently, a significant portion of households (approximately 33%) do not have access to clean or piped water, forcing residents in some areas to resort to fetching water from streams and rivers, which poses health risks.

The participants also note that increasing water supply capacity is a time-consuming process, requiring long periods to put additional infrastructure in place. However, the funding required for such initiatives is not readily available, exacerbating the challenge of meeting the growing demand for clean drinking water. Furthermore, the discrepancy between the rising demand for water and the municipality's limited supply potential has led to water protests from disgruntled residents in areas such as Fairview, Mahehle, and Ncakubana, highlighting the urgency of addressing this issue.

For example, one participant stated that *"does not have enough water supply infrastructure like dams and boreholes to supply the large parts of areas under HGDM. This explains reasons why almost 33 % [of] households under our municipality are without clean or piped water. Some areas, such as Eskhesheni, parts of Bulwer and*

Donnybrook, Kwasani and Mdayane [have] people who are still fetching water from streams and rivers; ostensibly, this has led to supply bottlenecks on the part of the municipality, hence the failure to adequately supply clean drinking water to all residents who need the water".

The key challenges highlighted by the participants include rapid population growth outpacing water supply capacity, a lack of adequate water supply infrastructure, the time-consuming process of increasing capacity, limited funding, and widespread dissatisfaction among residents due to inadequate access to clean drinking water. Thus, the municipality does not have adequate water supply reservoirs or infrastructure in the form of dams and boreholes to adequately supply safe drinking water to all the people in need under HGDM's jurisdiction. The lack of adequate capacity to supply water against rising demand was also identified among the challenges affecting the municipalities of South Africa by Baietti and Curiel (2017) and Tacoli, McGranahan and Satterthwaite (2015).

5.3.1.4 High cost of treating water

The high cost of treating water can become burdensome to any municipality, especially if it does not have enough revenue. Therefore, municipalities are expected to devise initiatives to reduce the cost of treating water. Participants also expressed concern over the rising cost of treating water. The findings highlight that the municipality is grappling with the challenge of high costs associated with treating water, which is attributed to the poor quality of water sources used for supply. Participants highlighted the alarmingly high levels of E. coli contamination found in certain rivers, such as the Polela River and the uMzimkhulu River.

Specifically, the uMzimkhulu River recorded E. coli levels exceeding 3 500 colony-forming units (CFUs) per 100 ml, which is significantly higher than the acceptable level of 1 000 CFUs per 100 ml. This high level of contamination necessitates the use of additional treatment processes and chemicals to ensure that the water is safe for human consumption. Consequently, the municipality has been forced to increase its expenditure on water treatment processes, placing a substantial financial burden on its limited resources. Participant 3 highlighted that the cost of treating water has been

rising annually, primarily due to the need for more rigorous treatment processes to address the poor quality of the water. Another factor corroborating the findings is that the municipality's water treatment budget is excessively high due to the poor quality of water drawn from sources such as the Luhane River at the intersection of R612 and R617 roads, the uMzimkhulu River, and more recently, the Ngwangwane River.

For example, one participant stated that *"… compared to other cost centres, the cost of treating water is rising every year. This is because the DWS discovered high levels of E. coli in the Polela River [and the] uMzimkhulu River, with the latter recording E. coli levels of over 3 500 colony-forming units (CFUs) per 100ml compared to the acceptable level of 1 000 CFUs per 100ml,within the water, meaning that we had to increase the number of processes and chemicals to treat the water and this has increased the cost against our limited financial resources".* The high cost of treating water contributes to a municipality's increased financial overheads. In summary, the findings reveal that the municipality is facing significant financial challenges due to the high cost of treating water, which is a direct consequence of the poor water quality in several rivers used as water supply sources. The presence of high levels of E. coli contamination in these water sources necessitates extensive treatment processes, resulting in increased expenditure on chemicals and treatment methods that strain the municipality's limited financial resources. McPhail et al. (2014) also asserted that some failure to safeguard water sources from pollution and the emergence of poor-quality water infrastructure that fatally undermines fair and affordable access to water services is attributable to corruption.

5.3.1.5 Influence of political interference and corruption

Recently, political interference and corruption have been topical in the South African national discourse and have generated serious debates and engagements within the country's political and civil society spaces. Though political interference and corruption have widely been associated with crippling service delivery in most municipalities, this vice seems to be also affecting HGDM. Political interference and corruption were also cited as another challenge affecting the HGDM's water supply capability. Some participants were of the view that certain politicians and administrators deployed as

part of administrative staff were culpable for committing acts of corruption within the municipality, hence causing water supply challenges.

The findings reveal that the problem of certain areas not getting either bulk water supplies, boreholes, or piped water is due to the fact that money allocated to the municipality through the municipal infrastructure grant cannot be accounted for as some powerful politicians acting in cahoots with contractors and municipal staff diverted some of the funds for personal benefit, resulting in many planned water projects not being completed on time or being completely abandoned.

One of the participants stated, *"Most of the administrators here are politicians by themselves and got their positions due to their political standing in the province. Now the problem is that they are colluding with other politicians to steal money for water projects, resulting in limited availability of water within the four municipalities. As a fieldworker, I have witnessed that on paper, more boreholes have been planned and budgeted for year on year, but on the ground, there are fewer boreholes than those recorded on paper. This points to some funds having been corruptly misappropriated. On paper, they recorded that KwaSkeyi has four boreholes drilled, but on the ground, there is only one. Another contractor was allocated R23 million for [the] construction of Stephen Dlamini Dam, but just did some shoddy clearing of the site and left for good. Nothing was done to follow up on that money, suggesting that some managers are complicit in the deal"*.

The participants highlighted that the municipality is facing water supply shortages due to significant delays in the implementation of numerous water projects. These delays are attributed to undue political interference and infighting, which have hindered the municipality's ability to establish adequate water supply reservoirs. Water projects along the Ngwangwane River, as well as Scheme 7 along the uMzimkhulu River within the Mgodi/Mhlabashane area, among others, are specific examples of delays.

One participant pointed out that some politicians are primarily motivated by personal gain rather than service delivery. This has led to instances of misappropriation of funds intended for water projects. The excerpt mentions the Stephen Dlamini Dam project, scheduled for completion in 2015 remains incomplete. A forensic audit revealed that over R36 million went missing from this project, and although investigations identified

the culprits, no arrests have been made due to political interference. *“The problem in our municipality is that there are some politicians who are after their pockets and who do care about service delivery. Lots of money went missing, and some of these political administrators are implicated; for example, the Stephen Dlamini Dam, which was supposed to be completed in 2015, is still incomplete, and [a] forensic audit revealed that over R36 million went missing. Some investigations were conducted, and culprits were identified, but due to political interference, there were no arrests up to now, so this problem is affecting [the] availability of water throughout the province”.*

Another participant, a field worker, reported witnessing discrepancies between the number of boreholes recorded on paper and the actual number of boreholes constructed on the ground. For instance, in the KwaSkeyi area documented four boreholes, but only one was physically present, suggesting funds may have been misappropriated. Furthermore, the participant cited an example where a contractor was allocated R23 million for the construction of the Stephen Dlamini dam but only performed minimal site clearance before abandoning the project, implying potential collusion between contractors and municipal managers. The excerpts suggest that political interference, corruption, and misappropriation of funds intended for water projects have significantly contributed to the municipality's water supply shortages.

The delays in implementing these projects have resulted in a lack of adequate water supply reservoirs, exacerbating the water availability issues within the municipality and the broader province. Deliberate disregard of investigation reports and evident reluctance to bring corrupt elements to face criminal justice for their corrupt acts have led to the loss of millions of Rands, which were supposed to be used for the completion of water supply projects such as the Stephen Dlamini Dam, adequate boreholes in areas like KwaSkeyi, and the expansion of existing water treatment works in areas such as Ntsikeni, Lourdes, Stepmore, Nokweja and others.

Some powerful politicians, in collusion with contractors and municipal staff, diverted funds allocated to the municipality through the municipal infrastructure grant, leaving certain areas without bulk water supplies, boreholes, or piped water, leading to delays or complete abandonment of many planned water projects. Another participant stated that. It is clear from the interview excerpts that administrators in the municipality are themselves politicians who are also conniving with other fellow politicians to corruptly

divert municipal funds earmarked for water projects for personal gain. Cullis et al. (2016) attributed the problem of poor water quality management to poor cooperative governance and financial mismanagement, which have hampered the ability of municipalities to reinvest in more water infrastructure projects and repair all ageing water infrastructure. Corruption at the upper levels of the water supply chain, particularly at the leadership and managerial levels, cripples the efficiency of the water distribution sector (Nkabane and Nzimakwe, 2018).

5.3.1.6 Impact of adverse weather conditions

Unfavourable weather in the form of droughts was also cited as another challenge affecting water supply within HGDM. Though quite a few participants cited drought as a significant challenge affecting the municipality, two participants elaborated on the extent to which drought has impacted the supply of water to HGDM residents. One participant stated that *"… occasionally we do experience serious droughts in our region and this often leads to drastic reductions in dam levels to such an extent that the municipality ends up restricting water to residents. For example, during the 2015 drought year, Ixopo Dam reached critical low level of 30% capacity resulting in water shortages throughout most urban areas including Ixopo, Rietvlei, Centacow, Swartberg, Riverside, Ibisi, and Ntwasahlobo. I need to reiterate that these droughts are now frequent these days such that water levels in rivers, and underground are also becoming affected and sometimes the municipality has little to do except to call for water rationing during these times".*

The participant's views expressed above demonstrate that adverse weather conditions, prevailing high temperatures, and subsequent droughts are causing water levels in dams, rivers, streams and water tables supplying boreholes to fall, leading to water supply shortages. During dry seasons, traditional sources of water dry up at a faster rate, such that water service providers experience water supply shortages (Sutcliffe et al., 2016). Erratic rainfall patterns and climate change resulting from global warming have equally challenged the water distribution sector. The interview excerpts highlight that the municipality occasionally experiences severe droughts in the region, which lead to drastic reductions in water levels in dams, rivers, and underground water

tables. Consequently, the municipality is forced to implement water restrictions and rationing for residents during these drought periods.

One participant cited the example of the 2015 drought, where the Ixopo dam reached a critically low level of 30 % capacity, resulting in water shortages across most urban areas, including Ixopo, Rietvlei, Centocow, Swartberg, Riverside, Ibisi, and Ntwasahlobo. Droughts have become more frequent in recent times, adversely affecting water levels in rivers and underground water sources. As the available water resources became insufficient to meet the demand, the municipality had limited options other than to call for water rationing during these periods.

Another participant stated that "*the municipality always complain[s] of financial constraints as a challenge, but I do need to point to you that water shortages are also due to inadequate rain and outright droughts, and high temperatures are also among the challenges that the municipality is faced with. These days, temperatures are too high, and this is causing high evaporation rates of water in rivers, streams [and] dams, and even droughts are more pronounced these days, and in some cases, there is not enough water for irrigation, domestic consumption and even animals. Our cattle, goats and sheep are affected by these adverse weather conditions that are befalling us, even communities getting their water boreholes are affected since the water table also falls drastically, leading to boreholes drying up hence the water shortages".*

Participants also pointed out that high temperatures and increased evaporation rates have exacerbated the water shortage situation during droughts. The high temperatures cause rapid evaporation of water from rivers, streams, and dams, further depleting the available water resources. The impact of droughts extends beyond domestic water supply, as participants mentioned that even irrigation and livestock watering activities are affected. During these periods, there may not be enough water for crop irrigation, domestic consumption, or watering animals such as cattle, goats, and sheep. Furthermore, the excerpts highlight the impact of droughts on areas dependent on boreholes for water supply, where the water table levels drop dramatically, leading to the drying up of boreholes and the subsequent dysfunction of water schemes.

In summary, the participants emphasise that droughts, compounded by high temperatures and evaporation rates, pose a significant challenge to the municipality's water supply. These climatic conditions result in critically low water levels in dams, rivers, and underground sources, forcing the municipality to implement water rationing and leaving various sectors, including domestic consumption, agriculture, and livestock watering, with insufficient water resources (Bates et al., 2018).

5.3.2 Drivers of water supply challenges in the municipality

The study findings indicated that several factors are essential elements that contribute to the driving challenges that affect municipalities. The degree to which drivers of water supply challenges affect municipalities differs from area to area. Some identified drivers of financial challenges include an unsustainable lower revenue base, sub-economic tariffs, a high debtor default rate, corruption, and pollution. Hellandendu (2017) pointed out that water loss is one of the critical challenges affecting most municipalities in developing countries due to old, dilapidated and unmaintained water infrastructure.

Failure to safeguard water sources from pollution and the emergence of poor-quality water infrastructure that fatally undermines fair and affordable access to water services are attributable to corruption (McPhail et al., 2014). During dry seasons, traditional sources of water dry up at a fast rate, such that water service providers experience shortages in water supplies (Sutcliffe et al., 2016). Bates et al. (2018) also asserted that erratic rainfall patterns and climate change resulting from global warming have equally challenged the water distribution sector.

In this section, the focus is on discussing the drivers of water supply challenges commonly experienced by the municipality. A culture of civil disobedience, particularly when it comes to honouring obligations that are related to consumed public services, drives financial challenges faced by municipalities (Lube and Rossouw, 2015). Also, non-payment for municipal services and the charging of sub-economic tariffs have resulted in the amounts owed to municipalities ballooning exponentially over the years (Kruger, 2018). Also, the financial challenges facing municipalities are compounded

by the existence of a high debtor default rate and a high indigent population (Lube and Rossouw, 2015; Kruger, 2018).

High levels of pollution in water sources cause the cost of treating chemicals to balloon to unsustainable levels, compounding the financial challenges facing municipalities. is compromised by Harmful chemical substances and other industrial waste compromise the quality of water in the main river sources, leading to an increase in the cost of water treatment (Molobela and Sinha, 2014; van Rensburg et al., 2016). Leroy (2019) also pointed out that poor farming practices have resulted in the contamination of water bodies with fertiliser residues and other agricultural chemicals. Cullis et al. (2016) and Leroy (2019) further stated that poor farming methods, including inappropriate dry-land tillage, discordant dry-land crops, over-irrigation, discordant irrigation technology, poor intercepting drainage, and ineffective irrigation water conveyance practices, have a negative effect on the quality of water sources. Rakodi (2016) adds that increased industrial waste discharged into various water bodies plays a significant role in the contamination of water sources and hence increases the cost of water treatment, which imposes a serious financial burden on the municipalities. The study has identified the following drivers of the water challenges:

5.3.2.1 Discharge of waste material into water supply sources

The discharge of agricultural chemicals, industrial waste, and human waste is one of the factors causing the cost of treating water to rise to unsustainable levels. This problem is compounded by poor agricultural practices, illegal dumping of waste by industries and households into water sources, eutrophication as the common driver of water pollution, and the high cost of treatment of municipal water. Some participants stated that there were high levels of E. coli in some of the rivers, such as uMzimkhulu River, the Luhane River, and Ngwangwane River. The high discharge of waste into water supply sources, caused HGDM to spend significant sums of money on treating the water to make it fit for human consumption.

Another participant stated that *“compared to other cost centres, the cost of treating water is rising every year. This is because the DWS discovered high levels of E. coli in [the] Polela River [and] Luhane River at the intersection of R612 and R617 roads,*

Ngwangwane River and of [the] uMzimkhulu River with the latter recording E. coli levels of over 3 500 colony-forming units (CFUs) per 100 ml compared to the acceptable level of 1 000 CFUs per 100 ml, within the water, meaning that we had to increase the number of processes and chemicals to treat the water, and this has increased the cost against our limited financial resources".

Another participant stated that HGDM is largely a rural municipality surrounded by many commercial farms. This has presented a challenge, as numerous chemical compounds used in agriculture find their way into water bodies that act as sources of water for the residents. This has led to high levels of chemical and toxic contents in our rivers, thereby contributing to the high cost of water treatment. Thus, the discharge of agricultural chemicals, industrial waste and human waste into water supply sources leads to high levels of pollution, requiring substantial amounts of money to buy the requisite amount of chemicals to treat the water before it reaches the distribution points for human consumption.

5.3.2.2 Unsustainable low revenue base

For municipalities to be financially stable, they need to have a sustainable revenue base in the form of a large pool of ratepayers who are honouring their obligations to pay tariffs on time. However, the findings from this study revealed that the municipality's financial challenges stem from the fact that HGDM has a high indigent population.

One participant stated that *"you see, our financial challenges are driven by the fact that we are too rural, most of our people are too rural, and most are unemployed and according to the indigent policy, we are not obliged to charge them for water supplied by the municipality, either be it piped water, stand pipe, bulk water supplied by our distribution partner, Umgeni and so forth, so we are left with a small population of urban dwellers who are eligible to pay for water rates".* The municipality management needs to craft strategies to increase the revenue collection base by, among other things, taking tough measures against defaulters. The municipality's water budgets suffer due to numerous rate payers falling behind on their municipal rate payments,

which hinders the municipality's ability to upgrade or repair its water supply infrastructure.

5.3.2.3 Sub-economic tariffs

Sub-economic tariffs lead to financial challenges. If tariffs are set below the economic recovery rate, the municipality will experience financial challenges, especially if there are no other sources of income. One participant stated that *“there are three things I believe are leading to financial challenges. Firstly, the water charges are too cheap; it’s like giving free water to ratepayers; that’s [why] we are always crying about money all the time, the municipality is not getting enough revenue from its ratepayers. Secondly, the municipal infrastructure grant we get from the government is not enough because there are so many competing needs. … Thirdly, municipal funds for various projects are being stolen, and auditors have been pointing to this over the years”.*

The municipality's sub-economic tariffs are the root cause of HGDM's financial problems, preventing it from adequately recovering the cost of providing water to rate payers. As a result, the municipality’s water budget is always in deficit, which hinders its ability to provide high-quality water services, address leaks, and repair water infrastructure.

5.3.2.4 High levels of population growth

The challenge of excess demand over supply capacity is driven by, among other issues, rising population growth. Participants stated that HGDM has of late experienced an influx of migrants, and rising population growth due to natural causes. This has caused the demand for water to exceed the existing capacity to supply water.

One of the respondents stated that “*we do not have adequate clean water supply sources to meet demand due to [the] high influx of migrants into our urban areas and the sprouting of many new unplanned settlements, so our water supply capacity is overstretched, and this problem is compounded by the fact that it takes quite a long*

time to increase water supply capacity since additional water supply capacity takes long periods of time to put in place and yet the funding for this is not readily available".

Further to this, participants stated that the urban population of HGDM is growing very fast, which has led to an increase in the demand for more water. Unfortunately, this population increase and the increase in demand for clean drinking water are outstripping HGDM's supply potential, hence giving rise to water protests from disgruntled residents, as witnessed by protests in Fairview, Mahehle and Ncakubana.

5.3.3 Municipal responses to water supply challenges

Depending on the challenges municipalities face, the respective management can devise a host of responses to address the unique issues they encounter at the local level. Solutions such as practising good corporate governance in municipalities and the effective separation of duties for politicians and the management of the municipality can solve the challenge of political interference and corruption (Franks and Cleaver, 2017; Neil, 2012). Meanwhile, Rakodi (2016) recommends enforcing payment of rates through legal channels or through water disconnections to solve challenges related to high debtor default rates. The debt collection policy provides a structure within which a municipality can practice its administrative and legislative powers to manage debts owed to it by its residents (Pollitt, 2015). This policy is used to establish a municipal credit strategy that is aligned with the national credit policy framework. Such a strategy would ensure that debts payable to the municipality are collected in an economic and sustainable manner. Muyunda (2017) suggests that to overcome water service challenges, particularly water shortages due to climate change, there is a need to look after and manage water sources sustainably through education and awareness campaigns. Innovative ways of obtaining more funding from provincial and central government and from the donor community also act as solutions to financial challenges facing municipalities (Cullis et al., 2016).

5.3.3.1 Education and awareness solutions to water challenges

Education and awareness play a critical role in resolving some of the water supply challenges facing municipalities. If community members are educated and made aware of the virtues of paying for their consumption of water and other municipal services, the financial burden facing municipalities will be lessened. The strategy of educating people to pay for municipal services is more compelling and critical, especially for those members of the community who are eligible to pay and who can afford to pay for those services. Participants stated that the municipality and civic organisations should roll out an education and awareness campaign to help influence ratepayers to pay their bills on time.

One participant stated that *"some of [the] people are not aware that they are the main cause of water supply challenges as they prejudice the municipality of money that is needed to help in the supply of water, and I recommend that they need a strong and sustained education and awareness campaign".* There is no doubt that this strategy will result in an increase in the number of ratepayers; hence, it boosts municipal financial resources as it capacitates municipalities to be able to repair and replace aged and dilapidated water infrastructure and to expand water connections to those who need it.

5.3.3.2 Water disconnections to defaulters

Punitive measures, such as disconnecting water for those ratepayers who default on paying their bills, can be an effective strategy to force people to pay and ameliorate the financial position of municipalities. The strategy is effective, especially if it adheres to the law and if the municipality implements the strategy on a sustained and consistent basis without fear or favour. Some participants stated that some ratepayers deliberately default on paying their bills, even when they can afford to pay. Consequently, they proposed that the municipality disconnect water supplies to those who can afford to pay but do not. One participant stated that *"defaulting ratepayers can only be made to pay if the municipality conducts a no-excuse campaign of disconnecting water as a strategy of making them pay on time". S*ince no one can survive without water for long, this strategy is effective. This strategy can also help

reduce municipal financial challenges and increase inflows into municipal coffers. More inflows of money into municipal coffers can help fund many water projects and increase the water supply.

5.3.3.3 Financial mobilisation

Financial mobilisation from the central government and donor agencies is also an effective strategy, especially if it is done in accordance with the law. As municipalities receive conditional grants and municipal infrastructure grants from the central government, there is also a need for the municipal leadership, in conjunction with the local political leadership, to make representations to the government to mobilise for more funding to repair or replace old, aged water infrastructure and bring new, efficient water supply equipment and infrastructure. The same approach can be applied to donors; both the municipal leadership and the local political leadership can approach donors to mobilise additional funding. Participants also suggested this approach and implored the municipality management to apply for additional funding from the government and for donor support where possible.

One participant said that "*since the municipality has limited financial resources, the local politicians, community leaders, and municipal leaders must come together and make representations to the government and to donors also for help with additional funds for building additional water supply capacity".* This finding suggests a multi-stakeholder collaboration to mobilise additional funding from the government and donor agencies to help capacitate the municipality to generate more water supply capacity.

5.3.3.4 Budgetary reprioritisation to fund water infrastructure

Budgetary reprioritisation to fund water infrastructure can be a good strategic option, especially if the municipal leadership is able to get support from various stakeholders. Some participants also stated that budgetary reprioritisation is a possible option when a municipality is faced with a limited budget and limited financial resources. One

participant expressed the view that *"since funds accruing to the municipality are not enough, municipality leaders should identify projects which can be shelved for some time and channel more funds to water supply projects".* This strategy is possible if other projects are not urgent, and stakeholders are convinced that water supply challenges have become unbearable to such an extent that people's lives are in danger.

5.4 Conclusion

This chapter presented the study's qualitative findings. Municipalities face multifaceted challenges in ensuring an adequate and reliable water supply. The challenges include incapacity to meet the increasing water demand, population growth, inadequate financial resources, aged and dilapidated water infrastructure, high water treatment costs, and adverse weather conditions. Most importantly, the chapter shows that municipal financial constraints stem from an unsustainable revenue base, sub-economic tariffs and limited fund allocations. In addition, the chapter illustrated the detrimental impact of political interference and corruption on water supply projects, which includes fund misappropriation, project delays, and shoddy workmanship by contractors. Facing the challenges, the municipality implemented measures including public education and awareness campaigns, water disconnections for defaulting residents, financial mobilisation efforts, and budgetary reprioritisation to fund water infrastructure development.

CHAPTER 6

CONCLUSION

6.1 Introduction

Chapters 4 and 5 focused on the presentation of the study's findings, emphasising household surveys and employee interviews. In this chapter, the emphasis is on concluding the study by conveying a summary of the study, a triangulation of results, determining recommendations, and exploring policy implications. The chapter is classified into fields of the study's summary, triangulation, recommendations, study limitations, and policy implications. The final section concludes the chapter.

6.2 Summary of the study

The study aimed to examine the determinants of water service delivery challenges at the HGDM. It adopted a mixed-methods approach, analysing data from households and employees at the Water Services Department at the HGDM. Quantitative data were collected from the households through a survey, while qualitative data were collected from municipal employees. Descriptive statistics and the principal component factor model were used to analyse the quantitative data. On the other hand, the thematic approach was used to analyse qualitative data. Several findings were reported in the study.

The HGDM faces multifaceted challenges in ensuring adequate and reliable water supply to residents. The most prevalent challenge identified is the inability of the water supply capacity to meet the increasing demand, driven primarily by rapid population growth in the region. This mismatch between supply and demand has resulted in widespread water shortages and dissatisfaction among residents. Exacerbating this supply-demand gap are several underlying factors, including inadequate financial

resources, aged and dilapidated water infrastructure, high water treatment costs, and adverse weather conditions such as droughts.

The municipality’s financial constraints stem from an unsustainable revenue base with sub-economic tariffs and a significant portion of the population classified as indigent, limiting the funds available for water infrastructure maintenance and expansion. Furthermore, findings highlighted the detrimental impact of political interference and corruption on water supply projects. Instances of fund misappropriation, project delays and shoddy workmanship by contractors hindered the timely completion of critical water infrastructure developments, further exacerbating the water supply challenges faced by the municipality. The discharge of waste materials into water sources has also emerged as a significant concern, contributing to the high costs of water treatment and posing potential health risks to residents. Climate change and associated effects, such as prolonged droughts and high temperatures, compounded water supply challenges by reducing the availability of water resources and increasing evaporation rates.

In response to the challenges, the municipality has implemented various measures, including public education and awareness campaigns, water disconnections for defaulting residents, financial mobilisation efforts, and budgetary reprioritisation to fund water infrastructure development. However, the effectiveness of the responses appears to be limited, as the underlying issues persist and continue to undermine the municipality's ability to provide a reliable and adequate water supply to residents.

The findings underscore the urgent need for a comprehensive and integrated approach to address water supply challenges faced by the municipality. This approach should encompass strategies to improve financial sustainability, accelerate infrastructure development, enhance water resource management, combat corruption, and adapt to the impacts of climate change. Without concerted efforts to tackle these multifaceted challenges, the municipality's ability to meet the water needs of its growing population remains severely compromised.

6.3 Triangulation of quantitative and qualitative findings

Most importantly, the research results involved the triangulation of household and employee findings. The findings regarding water supply challenges HGDM revealed common themes and areas of convergence. Both household surveys and employee interviews highlighted financial challenges as a significant factor affecting the water supply at the HGDM. The municipality faces constraints in funding allocation, revenue collection, and financial mismanagement that hamper its ability to deliver sufficient quantity and quality of water to residents. Moreso, both sources have identified aged and dilapidated water infrastructure as a major challenge. Outdated equipment, frequent breakdowns, and leakages in water pipes contribute to water losses and have an impact on the reliability of the water supply.

Furthermore, insufficient water supply infrastructure exacerbates the problem, especially in rapidly growing urban areas. Political interference and corruption were cited as significant challenges affecting water supply in both household surveys and employee interviews. Political motivations and corruption lead to delays in project implementation, misappropriation of funds, and diversion of resources intended for water projects, ultimately compromising service delivery. Both sources acknowledged adverse weather conditions, such as droughts, as a challenge impacting water supply. Droughts led to reductions in water levels in dams, rivers, and underground sources, necessitating water restrictions and rationing. High temperatures and increased evaporation rates exacerbate the situation during dry spells.

Both household surveys and employee interviews identified financial challenges as a significant factor affecting water supply in the municipality. This includes issues such as unsustainable revenue bases, sub-economic tariffs, high debtor default rates, and corruption. Pollution of water sources emerged as a critical concern in both datasets, with factors such as industrial waste, agricultural chemicals, and human waste contributing to water contamination. Infrastructure issues, such as old pipes and sewage management, were identified as potential determinants of water supply challenges in both household surveys and employee interviews.

There are also differences in both quantitative and qualitative data sets. The household survey highlighted non-payment for municipal services as a contributing

factor to poor water supply. This indicates challenges with revenue collection, which further strains municipal finances. Non-payment occurs in both affluent and impoverished areas. This suggests a broader issue with revenue management. The household surveys focused on quantifying the perceptions of residents regarding water supply challenges. The employee interviews provided qualitative insights into the broader challenges faced by municipalities. Household surveys also identified industries and illegal connections as significant contributors to water supply challenges.

Industrial waste discharge into water sources and vandalism of water infrastructure through illegal connections impact water quality and infrastructure integrity. While both datasets highlighted financial challenges, the household surveys delved deeper into specific supply-side and demand-side factors, such as politics, illegal connections, and exclusion of the community, which were not as prominently discussed in the employee interviews. Conversely, the employee interviews provided more detailed information about the impact of climate change, erratic rainfall patterns, and population growth on water distribution issues. Employee interviews emphasised the mismatch between water supply capacity and demand, driven by population growth and urbanisation. High demand for water outstrips supply capacity, leading to shortages, protests, and dissatisfaction among residents.

6.4 Policy implications and recommendations

Based on the triangulated findings from both household surveys and employee interviews regarding water supply challenges at the HGDM, the senior management at the HGDM should implement robust financial management practices to ensure transparent budget allocation, expenditure tracking and accountability, and strengthen revenue collection mechanisms to address high debtor default rates and non-payment for municipal services. The municipality should also consider revising water tariffs to reflect the true cost of service delivery while ensuring affordability for residents, potentially through targeted subsidies for vulnerable populations. Senior management should develop a comprehensive infrastructure rehabilitation plan to address aged and dilapidated water infrastructure, including pipes, treatment plants, and distribution

networks. They also should prioritise infrastructure maintenance to reduce water losses from leaks and breakdowns, thereby improving the reliability and efficiency of water supply systems.

Further, senior management should enforce stricter regulations and monitoring mechanisms to prevent industrial pollution, illegal connections, and contamination of water sources, as well as invest in advanced water treatment technologies to mitigate the impact of pollution and ensure the delivery of safe and clean drinking water to residents. It is important that senior management implement measures to combat political interference, corruption, and misappropriation of funds in water infrastructure projects. Most importantly, senior management should enhance transparency and accountability in procurement processes, contract management, and project implementation to prevent corruption and ensure optimal use of resources.

Senior management should develop climate-resilient water resource management strategies to mitigate the impact of adverse weather conditions, such as droughts and erratic rainfall patterns, and invest in alternative water sources, such as rainwater harvesting, groundwater recharge, and desalination, to enhance water security and resilience to climate change. Considering study findings, it is recommended that HGDM integrates water service delivery interventions aligned to SDGs such as Goal 3, 6, 8, and 11. Using this approach requires the creation of a multi-stakeholder engagement that fosters community-based initiatives. This also ensures robust monitoring of water service delivery. Applying such a framework ensures that HGDM address water service delivery challenges, coupled with contributing to South Africa's commitment towards the UN 2030 Agenda.

6.5 Limitations of the study and areas of future research.

Several areas for future research were identified based on the triangulated findings from both household surveys and employee interviews regarding water supply challenges in the HGDM. First, future researchers can investigate the vulnerability of water supply infrastructure to climate change impacts, such as changing precipitation patterns, increased frequency of extreme weather events, and long-term shifts in hydrological cycles. They can also assess the effectiveness of adaptation measures,

such as water storage facilities, drought-resistant technologies, and sustainable water management practices.

Second, future research should examine alternative revenue generation models for financing water supply infrastructure and services, including public-private partnerships, user fees and innovative financing mechanisms. It should assess the impact of financial reforms on improving revenue collection, reducing debt default rates, and enhancing financial sustainability. Alternatively, future research should evaluate the effectiveness of infrastructure rehabilitation programmes in addressing the challenges of aged and dilapidated water infrastructure. Finally, the impact of maintenance strategies, asset management systems and technology upgrades on reducing water losses and improving the reliability of water supply systems should be evaluated. The future research should look at opportunities such as the role of digital technologies in improving water supply systems. Exploring areas such as operational efficiency, financial management, climate resilience, and community engagement through digital innovation would provide valuable insights and align with contemporary global trends.

6.6 Conclusion

This chapter summarised the water supply challenges in the HGDM. Firstly, a summary of the study findings was explored to illustrate the fundamental discoveries of the study. This was followed by a detailed discussion on the triangulation of quantitative and qualitative findings. The discovery points to water supply challenges that included funding limitations, revenue collection issues, and financial mismanagement. Equally so, both research findings point to infrastructure limitations, for example, aged infrastructure, frequent breakdowns and leakages. These challenges were compounded by political interference, corruption, and ever-changing climate conditions. Most importantly, the chapter explored the policy implications of the study findings for senior managers, provincial governments, and future research. It elaborated on the need for understanding governance dynamics, community engagement, climate change adaptation, financial management, infrastructure rehabilitation, water quality control, and integrated water resource management.

Therefore, the chapter synthesises the study findings, presents recommendations for action, identifies areas for future research, and underscores the importance of addressing water supply challenges in the HGDM.

References

Adeleke, B., Robertson-Andersson, D., Moodley, G. and Taylor, S., 2020. Aquaculture in Africa: A comparative review of Egypt, Nigeria, and Uganda vis-a-vis South Africa. *Reviews in Fisheries Science and Aquaculture*, *29*(2), pp.167–197.

Adeoye-Olatunde, O.A. and Olenik, N.L., 2021. Research and scholarly methods: Semi-structured interviews. *Journal of the American College of Clinical Pharmacy*, *4*(10), pp.1358–1367.

Adler, R.H., 2022. Trustworthiness in qualitative research. *Journal of Human Lactation*, *38*(4), pp.598-602.

Afifi, A. A., S. May, and V. A. Clark., 2012. *Practical multivariate analysis*. 5th ed. Boca Raton, FL: CRC Press.

Aiken, J., Belk, R.W., Bhattacharyya, A., Delcore, H.D., Desjeux, D., Hitch, E., Jingjing, M., Miller, C., Onomake, U.E.O., Newton, K.M. and Ramer, A., 2017. *Cultural change from a business anthropology perspective*. Lexington Books.

Aldrich, J.H. and Nelson, F.D., 1984. *Linear probability, logit, and probit models* (No. 45). Sage.

Alegre, H., Baptista, J.M., Cabrera Jr, E., Cubillo, F., Duarte, P., Hirner, W., Merkel, W. and Parena, R., 2016. *Performance indicators for water supply services*. IWA publishing.

Ameyaw, E.E. and Chan, A.P., 2015. Risk ranking and analysis in PPP water supply infrastructure projects: An international survey of industry experts. *Facilities*.

Amis, M. and Nel, D., 2011. Managing Water Risk: Business Response to the Risk of Climate Change in South Africa—A Synthesis. *WWF South Africa: Cape Town*, South Africa.

Aryal, N., Rimal, B., Sharma, R., Kunwar, R., Keshtkar, H., Stork, N.E., Rijal, S., Rahman, S.A. and Baral, H., 2019. Effects of land use and land cover change on ecosystem services in the Koshi River Basin, Eastern Nepal. *Ecosystem Services*, *38*, p.100963.

Asian Development Bank, 2014. Water resources project preparatory facility, project data sheet. Available: https:www.doi.org/10.1177/0486613410368496 [Accessed on 20 April 2021].

Avison, A., Quinn, L.J., Fuller, G.A., Caswell, J.L., Green, J.A., Breen, S.L., Ellingsen, S.P., Gray, M.D., Pestalozzi, M., Thompson, M.A. and Voronkov, M.A., 2016. Excited-state hydroxyl maser catalogue from the methanol multibeam survey–I. Positions and variability. *Monthly Notices of the Royal Astronomical Society*, *461*(1), pp.136-155.

Babbie, E., 2020.*The practice of social research*, Cape Town: Oxford University Press.

Baietti, A. and Curiel, P., 2017. The financial sustainability of water and sanitation supply services. *Working Note No 7, the World Bank.*

Baird, T., Corey, V.R., Sissom, J., Weber, J. and Campbell, S.H., 2021. Testing the validity and reliability of the adapted health communication assessment tool©. *Clinical Simulation in Nursing*, *52*, pp.50–58.

Basias, N. and Pollalis, Y., 2018. Quantitative and qualitative research in business and technology: Justifying a suitable research methodology. *Review of Integrative Business and Economics Research*, *7*, pp.91–105.

Bazovsky, I., 2012. *Reliability theory and practice*, Prentice-Hall, Inc.: Englewood Cliffs, NJ, USA.

Berkson, J., 1944. Application of the logistic function to bio-assay. *Journal of the American Statistical Association*, *39*(227), pp.357–365.

Bischoff-Mattson, Z., Maree, G., Vogel, C., Lynch, A., Olivier, D. and Terblanche, D., 2020. Shape of a water crisis: practitioner perspectives on urban water scarcity and ‘Day Zero’in South Africa. *Water Policy*, *22*(2), pp.193-210.

Bischoff-Mattson, Z., Maree, G., Vogel, C., Lynch, A., Olivier, D. and Terblanche, D., 2020. Shape of a water crisis: practitioner perspectives on urban water scarcity and ‘Day Zero’in South Africa. *Water Policy*, *22*(2), pp.193-210.

Black, P.E. and Fisher, B.L., 2018. *Conservation of water and related land resources* (No. P10 32). CRC Press.

Blignaut, J. and Van Heerden, J., 2009. The impact of water scarcity on economic development initiatives. *Water SA*, *35*(4).

Bloomfield, J. and Fisher, M.J., 2019. Quantitative research design. *Journal of the Australasian Rehabilitation Nurses Association*, *22*(2), pp.27-30.

Boccaletti, G. 2015. Confronting South Africa's water crisis. Available: http://www.mickinsey.com/insights/sustainability/confronting_south_africas_water_challenge [Assessed on 20 April 2021].

Booysen, S., 2014. Twenty years of South African democracy. *Citizen Views of Human Rights, Governance and the Political System. Washington: Freedom House*.

Borrego, M., Douglas, E.P. and Amelink, C.T., 2015. Quantitative, qualitative, and mixed research methods in engineering education. *Journal of Engineering Education*, *98*(1), pp.53–66.

Boyce, C. and Neale, P., 2014. A guide for designing and conducting in-depth interviews for evaluation input. *Pathfinder International*, p.16.

Brancati, D. 2018. *Social scientific research*. Sage Publishers, London.

Brookes, J.D., Carey, C.C., Hamilton, D.P., Ho, L., van der Linden, L., Renner, R. and Rigosi, A., 2014. *Emerging challenges for the drinking water industry*.

Buccus, I. Hemson, D. Hicks, J. and Piper, L., 2017. *Public participation and local governance.* Available: http://www.ecommons.hsrc.ac.za [Assessed on 10 February 2024].

Burger, R.W. and Bossert, J., 2016. Learning Governance and Sustainable Development: A case study of the City of Cape Town (COCT). *In 14th International Winelands Conference, Stellenbosch: South Africa*

Buthelezi, P., 2022. *An analysis of South Africa public entity performance using biomatrix systems thinking theory: A case of South African water boards* (Doctoral dissertation, Stellenbosch: Stellenbosch University).

Carr, G., Blöschl, G. and Loucks, D.P., 2012. Evaluating participation in water resource management: A review. *Water Resources Research*, *48*(11).

Cattell, R.B., 1966. The screen test for the number of factors. *Multivariate Behavioural Research*, *1*(2), pp.245–276.

Cerna, L., 2013. The nature of policy change and implementation: A review of different theoretical approaches. *Organisation for Economic Cooperation and Development (OECD) Report*, pp.492–502.

Chepyegon, C. and Kamiya, D., 2018. Challenges faced by the Kenya water sector management in improving water supply coverage. *Journal of Water Resource and Protection*, *10*(1), pp.85–105.

Cloete, J. J. N. and Thornhill, C., 2015. South African municipal government and administration: *A new dispensation, Dotsquare.*

Coetzee, L.M., Cassim, N., Sriruttan, C., Mhlanga, M., Govender, N.P. and Glencross, D.K., 2018. Cryptococcal antigen positivity combined with the percentage of HIV-seropositive samples with CD4 counts< 100 cells/μl identifies districts in South Africa with advanced burden of disease. *PLoS One*, *13*(6), p.e0198993.

Coffey, A. and Atkinson, P., 2014. *Making sense of qualitative data: Complementary research strategies*. Sage Publications, Inc.

Coles, Anne, and Tina Wallace, eds. 2020. *Gender, water and development*. Routledge.

Considine, J., Botti, M. and Thomas, S., 2005. Design, format, validity and reliability of multiple choice questions for use in nursing research and education. *Collegian*, *12*(1), pp.19-24.

Conţiu, L.C., Gabor, M.R. and Oltean, F.D., 2012. Employee's motivation from a cultural perspective–A key element of the hospitality industry competitiveness. *Procedia Economics and Finance*, *3*, pp.981–986.

Corbetta, P., 2013. *Social research: Theory, methods and techniques*. Sage.

Corbin, J. and Strauss, A., 2010. *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Sage Publications.

Creswell, J.W. 2021. *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage Publications.

Creswell, J.W. and Poth, C.N., 2018. *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications.

Cullis, J.D., Rossouw, N., Du Toit, G., Petrie, D., Wolfaardt, G., De Clercq, W. and Horn, A., 2016. Economic risks due to declining water quality in the Breede River catchment. *Water SA*, *44*(3), pp.464-473.

Cunningham, E., Cobb, A.D. and Jha, S., 2022, June. Principal component flows. In *International Conference on Machine Learning* (pp. 4492–4519). PMLR.

D'Ercole, M., Righetti, M., Raspati, G.S., Bertola, P. and Maria Ugarelli, R., 2018. Rehabilitation planning of water distribution network through a reliability—Based risk assessment. *Water*, *10*(3), p.277.

Damelin, E., Shamir, U. and Arad, N., 2004. Engineering and economic evaluation of the reliability of water supply. *Water Resources Research*, *8*(4), pp.861–877.

Daniel J., 2014. Choosing the type of probability sampling. Available: http://www.sagepub.com/upm-data/40803_5.pdf. [Accessed on 30 June 2021].

Daniel, B.K. and Harland, T., 2017. *Higher education research methodology: A step-by-step guide to the research process*. Routledge.

Daudu, I.A. and Fagbadebo, O., 2019. Public participation in legislative oversight: A review of nature and practice in Nigeria and South Africa. *Perspectives on the Legislature and the Prospects of Accountability in Nigeria and South Africa*, pp.233–250.

Dehalwar, K. and Sharma, S.N., 2024. Exploring the distinctions between quantitative and qualitative research methods. *Think India Journal*, *27*(1), pp.7–15.

Delcore, H.D., 2017. Changing Culture through Technology Adoption. *Cultural Change from a Business Anthropology Perspective*, p.69.

Denzin, N.K. and Lincoln, Y.S. eds., 2011. *The Sage handbook of qualitative research*. Sage.

Department of Water and Sanitation (DWAF). (2007). Free basic Water. South Africa: *Department of Water Affairs and Forestry*, pp1–47

Dhanya, P. and Ramachandran, A., 2016. Farmers' perceptions of climate change and the proposed agriculture adaptation strategies in a semi-arid region of south India. *Journal of Integrative Environmental Sciences*, *13*(1), pp.1–18.

Dithebe, K., Aigbavboa, C. and Thwala, D.W., 2019, May. An appraisal of water infrastructure projects' financing challenges in South Africa. In *10th Nordic Conference on Construction Economics and Organization*. Emerald Publishing Limited.

Doherty, M., 2014. Probability versus non-probability sampling in sample surveys. *The New Zealand Statistics Review*, *4*, pp.21–28.

Dos Santos, S., Adams, E.A., Neville, G., Wada, Y., De Sherbinin, A., Bernhardt, E.M. and Adamo, S.B., 2017. Urban growth and water access in sub-Saharan Africa: Progress, challenges, and emerging research directions. *Science of the Total Environment*, *607*, pp.497–508.

Dr Nkosazana Dlamini Zuma Local Municipality, 2017. Annual Reports, Available at: https://ndz.gov.za/annual-reports/ (Accessed on 18 April 2024).

Dr Nkosazane Dlamini Zuma Local Municipality (NDZLM) Report, 2017. Available: https://ndz.gov.za/budget-treasury/budget-reporting/annual -report/. [Accessed on 23 November 2023]

Dube, K., Nhamo, G. and Chikodzi, D., 2022. Climate change-induced droughts and tourism: Impacts and responses of Western Cape province, South Africa. *Journal of Outdoor Recreation and Tourism*, *39*, p.100–319.

Dunn, W.W., 2020. Validity. In *Developing norm-referenced standardized tests* (pp. 149–168). Routledge.

DWA, 2014. Water Boards as Regional Water Utilities. Available: https//www.dwa.gov.za/wsks/UserControls/DownloadImportFiles.aspx?FilesID=70. [Accessed on 20 April 2021]

Eagan, B., Brohinsky, J., Wang, J. and Shaffer, D.W., 2020, March. Testing the reliability of inter-rater reliability. In *Proceedings of the Tenth International Conference on Learning Analytics and Knowledge* (pp. 454–461).

El Batouti, M., Al-Harby, N.F. and Elewa, M.M., 2021. A review on promising membrane technology approaches for heavy metal removal from water and wastewater to solve water crisis. *Water*, *13*(22), p.32–41.

Enaifoghe, A.O. and Toyin, A.C., 2019. South Africa's decentralization problems of citizenry participatory democracy in local municipality development. *Affrika*, *9*(1), pp.91–116.

Environmental Monitoring Group, 2016. Press release: SAWC comments on Minister of Water and Sanitation's budget speech. Available: http:www.edges.ubc.ca [Accessed on 20 April 2021]

Etikan, I., Musa, S.A. and Alkassim, R.S., 2016. Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics,* 5(1), pp.1–4.

Fewtrell, L., Kaufmann, R.B., Kay, D., Enanoria, W., Haller, L. and Colford Jr, J.M., 2015. Water, sanitation, and hygiene interventions to reduce diarrhoea in less developed countries: a systematic review and meta-analysis. *The Lancet Infectious Diseases*, *5*(1), pp.42–52.

Fisher, M.J. and Marshall, A.P., 2009. Understanding descriptive statistics. *Australian Critical Care*, *22*(2), pp.93–97.

Fjeldstad, O.H., 2016. Revenue mobilization at sub-national levels in Sudan. *Sudan Report*.

Folger, R.G. and Cropanzano, R., 2014. *Organizational justice and human resource management* (Vol. 7). Sage.

Fonjong, L.N. and Ngekwi, M.A., 2014. Challenges of water crisis on women's socio-economic activities in the Buea Municipality, Cameroon. *Journal of Geography and Geology*, *6*(4), pp.122-131.

Forrester, J.W., 2007. System dynamics—the next fifty years. *System Dynamics Review: The Journal of the System Dynamics Society*, *23*(2-3), pp.359–370.

George, J.M., Jones, G.R. and Sharbrough, W.C., 2015. *Understanding and managing organizational behavior*. Upper Saddle River, NJ: Pearson Prentice Hall.

Gibson, J., Ivancevich, J. and Konopaske, R., 2016. *Organizations: Behaviour, structure, processes*. McGraw-Hill Higher Education.

Gibson, L., Le Roux, J., Msadala, V., Rooseboom, A. and Basson, G.R., 2010. Sediment yield prediction for South Africa: 2010 edition. *University of Stellenbosch and ARC/WRC Project K*, *5*.

Giordano, M. and de Fraiture, C., 2014. Small private irrigation: Enhancing benefits and managing trade-offs. *Agricultural Water Management*, *131*, pp.175–182.

Giordano, M. and Shah, T., 2014. From IWRM back to integrated water resources management. *International Journal of Water Resources Development*, *30*(3), pp.364–376.

Githiri, E.M., 2015. *Factors affecting customer service delivery: A case of Standard chartered bank Kenya* (Doctoral dissertation, United States International University-Africa).

Global Water Partnership South Asia, 2010. Newsline, Battaramulla, Sri Lanka: Available: https:www.tandfonline.com/loi/cijw20 [Accessed on 20 April 2021].

Gothren, P.G., 2018. Understanding rural water supply and access in South Africa (2013). Available: http:tepository.lib.ncsu.edu/dr/bitstream/1840.4/8147/1/ [Accessed on 20 April 2021].

Gounden, T., Pfaff, B., Macleod, N. and Buckley, C., 2016. Provision of free sustainable basic sanitation: *The Durban Experience.*

Grassini, S. and Laumann, K., 2020. Questionnaire measures and physiological correlates of presence: A systematic review. *Frontiers in psychology*, *11*, p.349.

Grgic, J., Lazinica, B., Schoenfeld, B.J. and Pedisic, Z., 2020. Test–retest reliability of the one-repetition maximum (1RM) strength assessment: a systematic review. *Sports Medicine-open*, *6*, pp.1–16.

Grigg, N.S., 2014. Integrated water resources management: unified process or debate forum? *International Journal of Water Resources Development*, *30*(3), pp.409–422.

Gumbi, N. and Rangongo, M.F., 2015. The challenges of water supply management: A case of uMdoni local municipality, KwaZulu-Natal province. *The Xenophobic attacks in South Africa: Reflections and Possible Strategies to ward them off*, p.895.

Gutiérrez-Malaxechebarría, A.M., 2013. Informal irrigation in the Colombian Andes: Local practices, national agendas, and options for innovation. *Mountain Research and Development*, *33*(3), pp.260–268.

Hamilton, L. C., 2013. Statistics with stata: Updated for version 12. 8th ed. Boston: Brooks/Cole.

Harrell, M.C. and Bradley, M.A., 2009. *Data collection methods: Semi-structured interview and focus groups.* RAND National Defense Research Institute, Santa Monica.

Harris, L.M., 2020. Assessing states: Water service delivery and evolving state–society relations in Accra, Ghana and Cape Town, South Africa. *Environment and Planning C: Politics and Space*, *38*(2), pp.290–311.

Harry Gwala District Municipality Annual Mayoral Report, 2018. Available: hhtp://www.harrygwaladm.gov.za/index.php/budget-and-treasury/budget-reporting/annual-report [Accessed on 14 June 2022]

Harry Gwala Mayor`s Annual Report, 2018. Annual Report Financial year 2018-2019, Available at: https://www.harrygwaladm.gov.za/images/downloads/annual-reports/2018-2019_Annual_Report.pdf (Accessed on 12 April 2024).

Harry Gwala Water Department Director`s Annual Report, 2021. Annual Report Financial year 2021-2022, Available at: https://www.harrygwaladm.gov.za/images/downloads/annual-reports/2021-2022_Annual_Report.pdf (Accessed on 12 April 2024).

Hashmi, A.R., Amirah, N.A., Yusof, Y. and Zaliha, T.N., 2020. Exploring the dimensions using exploratory factor analysis of disruptive factors and inventory control. *The Economics and Finance Letters*, *7*(2), pp.247–254.

Haydar, S., Nadeem, O., Hussain, G., Rashid, H. and Majeed, R., 2016. Drinking water quality in urban areas of Pakistan: A case study of Gujranwala city. *Pakistan Journal of Scientific and Industrial Research Series A: Physical Sciences*, *59*(3), pp.157–166.

Herman, L. and Vervaeck, B., 2019. *Handbook of narrative analysis*. U of Nebraska Press.

Hewitt, A., 2016. *Trends in global employee engagement*. Aon Hewitt Corp.

Hoffman, D.J. and Nkadimeng, L.M., 2016. Investigating water supply challenges in the Elias Motsoaledi Municipality of Limpopo Province, South Africa: A case of Motetema Settlement. Available at: *http://www.repository.up.ac.za* [Accessed on 12 July 2021]

Hoffman, D.J. Kamera, W. and Lombard, I., 2013. *Water supply challenges in Makhado Municipality, Vhembe district, Limpopo Province.* Associated Schools of Construction Conference, Cape Town, South Africa

Huang, Y., Shen, L. and Liu, H., 2019. Grey relational analysis, principal component analysis and forecasting of carbon emissions based on long short-term memory in China. *Journal of Cleaner Production*, *209*, pp.415–423.

Humphries, B., 2017. *Re-thinking social research: anti-discriminatory approaches in research methodology*. Taylor and Francis.

Jachimowski, A., 2017. Factors affecting water quality in a water supply network. *Journal of Ecological Engineering*, *18*(4), pp. 60–90.

Jachimowski, A., 2019. Effect of Different Disinfection Methods on Quality of Tap Water. *Geomatics and Environmental Engineering*, *13*(3), pp.47-57.

Jamieson, M.K., Govaart, G.H. and Pownall, M., 2023. Reflexivity in quantitative research: A rationale and beginner's guide. *Social and Personality Psychology Compass*, *17*(4), p.e12735.

Kanyane, M.H., 2011. Financial viability of rural municipalities in South Africa. *Journal of Public Administration*, *46*(2), pp.935–946.

Kazman, J.B., Galecki, J.M., Lisman, P., Deuster, P.A. and O'Connor, F.G., 2014. Factor structure of the functional movement screen in marine officer candidates. *The Journal of Strength and Conditioning Research*, *28*(3), pp.672–678.

Khan, A.R. and Khandaker, S., 2016. A critical insight into policy implementation and implementation performance. *Viesoji Politika ir Administravimas*, *15*(4).

Khuzwayo, Z. and Chirwa, E.M.N., 2020. The intricate challenges of delocalised wastewater treatment facilities with regards to water resource management capacity framework in South Africa. *Sustainable Water Resources Management*, *6*(1), p.6.

Kidd, M., Dellapenna, J.W. and Gupta, J., 2010. *The evolution of the law and politics of water* (p. 10). Dordrecht: Springer.

Kim, K.T. and Lee, J., 2018. Financial literacy and use of payday loans in the United States. *Applied Economics Letters*, *25*(11), pp.781–784.

Koma, S.B., 2012. *Developmental local government: issues, trends and options in South Africa*.

Kothari, C.R., 2012. *Research methodology: Methods and techniques*. New Age International.

Kruger, N., 2018. Quo Vadis? Collection of outstanding monies owed by municipal debtors. *IMFO: Official Journal of the Institute of Municipal Finance Officers*, *3*(3), pp.22–23.

Kumar, R., 2019. *Research methodology: A step-by-step guide for beginners*. Sage Publications Limited.

Kumari, N., Zhang, B., Zhang, R., Shechtman, E. and Zhu, J.Y., 2023. Multi-concept customization of text-to-image diffusion. In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition* (pp. 1931-1941).

Larsen, T.A., Hoffmann, S., Lüthi, C., Truffer, B. and Maurer, M., 2016. Emerging solutions to the water challenges of an urbanizing world. *Science*, *352*(6288), pp.928–933.

Lautze, J. and Manthrithilake, H., 2012. May. Water security: old concepts, new package, what value? In *Natural Resources Forum* 36(2), pp. 76–87.

Leal F. W., Totin, E., Franke, J.A., Andrew, S.M., Abubakar, I.R., Azadi, H., Nunn, P.D., Ouweneel, B., Williams, P.A., Simpson, N.P. and Global Adaptation Mapping Initiative Team, 2022. Understanding responses to climate-related water scarcity in Africa. *Science of the Total Environment*, *806*, p.150–420.

Leroy, D., 2019. Farmers' perceptions of and adaptations to water scarcity in Colombian and Venezuelan Páramos in the context of climate change. *Mountain Research and Development*, *39*(2), pp. R21–R34.

Limburg, 1986. *Principles on the implementation of the international covenant on economic, social and cultural rights (No.28).*

Lincoln, Y.S. and Guba, E.G., 1985. *Naturalistic inquiry*. Newberry Park.

Livingston, J., 2021. Water scarcity and health in urban Africa. *Daedalus*, *150*(4), pp.85–102.

Lukat, E., Pahl-Wostl, C. and Lenschow, A., 2022. Deficits in implementing integrated water resources management in South Africa: The role of institutional interplay. *Environmental Science and Policy*, *136*, pp.304–313.

MacPhail, A., Patton, K., Parker, M. and Tannehill, D., 2014. Leading by example: Teacher educators' professional learning through communities of practice. *Quest*, *66*(1), pp.39–56.

Madani, K., AghaKouchak, A. and Mirchi, A., 2016. Iran's socio-economic drought: challenges of a water-bankrupt nation. *Iranian Studies*, *49*(6), pp.997–1016.

Magaldi, D. and Berler, M., 2020. Semi-structured interviews. *Encyclopedia of personality and individual differences*, pp.4825–4830.

Mahadea, D. and Kabange, M., 2019. Influence of government regulations and institutions on entrepreneurial performance in Cameroon. *Journal of Developmental Entrepreneurship*, *24*(04), p.1950027.

Mahlangu, M. and Garutsa, T.C., 2014. Application of indigenous knowledge systems in water conservation and management: The case of Khambashe, Eastern Cape South Africa. *Academic Journal of Interdisciplinary Studies*, *3*(4), pp.151-160.

Marshall, G. and Jonker, L., 2010. An introduction to descriptive statistics: A review and practical guide. *Radiography*, *16*(4), pp. e1–e7.

Mashuri, S., Sarib, M., Rasak, A., Alhabsyi, F. and Syam, H., 2022. Semi-structured interview: A methodological reflection on the development of a qualitative research instrument in educational studies. *Journal of Research and Method in Education*, *12*(1), pp.22–29.

Matikinca, P., Ziervogel, G. and Enqvist, J.P., 2020. Drought response impacts on household water use practices in Cape Town, South Africa. *Water Policy*, *22*(3), pp.483–500.

Matlala, L.S. and Uwizeyimana, D.E., 2020. Factors influencing the implementation of the auditor general's recommendations in South African municipalities. *African Evaluation Journal*, *8*(1), pp.1-11.

Mauter M.S, Zucker I, Perreault F, Werber J.R, Kim J.H, Elimelech M., 2018. The role of nanotechnology in tackling global water challenges. *Nature Sustainability*. 1(4), pp.166–75.

McCall, Jr, Hollenbeck, G.P. and M.W., 2012. What makes a successful global executive? *Business Strategy Review*, *12*(4), pp.49–56.

McKenzie, P., Weldon, P.R., Rowley, G., Murphy, M. and McMillan, J., 2014. Staff in Australia's schools 2013: Main report on the survey.

McNamara, K.E., Olson, L.L. and Rahman, M.A., 2016. Insecure hope: The challenges faced by urban slum dwellers in Bhola Slum, Bangladesh. *Migration and Development*, *5*(1), pp.1–15.

McPhail, A., Locussol, A.R. and Perry, C., 2012. Achieving financial sustainability and recovering costs in bank financed water supply and sanitation and irrigation projects. Available: https://scholar.google.com/scholar?cluster=11437685422360041295&hl=en&assdt=0.5 [Accessed on 22 February 2024].

Meadows, D.H., 2008. *Thinking in systems: A primer*. Chelsea Green Publishing.

Miguel, A., 2014*. Optimal tax, MSc in Economics - University of Warwick*

Millington, N. and Scheba, S., 2021. Day zero and the infrastructures of climate change: Water governance, inequality, and infrastructural politics in Cape Town's water crisis. *International Journal of Urban and Regional Research*, *45*(1), pp.116–132.

Mirrlees, J.A. and Stern, N.H., 1972. Fairly good plans. *Journal of Economic Theory*, *4*(2), pp.268-288.

Mishra, P., Pandey, C.M., Singh, U., Gupta, A., Sahu, C. and Keshri, A., 2019. Descriptive statistics and normality tests for statistical data. *Annals of cardiac anaesthesi*a, 22(1), pp.67–72.

Mnembe, F.Q., 2022. *The nexus between project management and service delivery in the eThekwini Municipality* (Doctoral dissertation).

Mnguni, E.S., 2020. Review of water resources and management in South Africa. *WIT Transactions on Ecology and the Environment*, *241*, pp.197-206.

Modi, A.T. and Mabhaudhi, T., 2020. Water use of crops and nutritional water productivity for food production, nutrition and health in rural communities in KwaZulu-

Natal. *Water Research Commission (WRC), Pretoria, RSA, WRC Report No. KV*, *2493*(1), p.20.

Monette, D.R., Sullivan, T.J. and DeJong, C.R., 2014. *Applied social research: A tool for the human services*. Cengage Learning.

Montwedi, M., Munyaradzi, M., Pinoy, L., Dutta, A., Ikumi, D.S., Motoasca, E. and Van der Bruggen, B., 2021. Resource recovery from and management of wastewater in rural South Africa: Possibilities and practices. *Journal of Water Process Engineering*, *40*, p.101978.

Morse, J.M., Barrett, M., Mayan, M., Olson, K. and Spiers, J., 2012. Verification strategies for establishing reliability and validity in qualitative research. *International Journal of Qualitative Methods*, *1*(2), pp.13–22.

Mortoja, M.G., Yigitcanlar, T. and Mayere, S., 2020. What is the most suitable methodological approach to demarcate peri-urban areas? A systematic review of the literature. *Land Use Policy*, *95*, p.104601.

Mothetha, M., Nkuna, Z. and Mema, V., 2013. The challenges of rural water supply: *A case study of rural areas in Limpopo Province.*

Moyo, B., 2013. Power infrastructure quality and manufacturing productivity in Africa: A firm level analysis. *Energy Policy*, *61*, pp.1063–1070.*a*, *22*(1), p.67.

Moyo, L. and Wehn, U., 2017. Interaction dynamics: the case of the water sector skills plan in South Africa. *Evaluation and Program Planning*, *60*, pp.91–99.

Muller, M., 2017. Free basic water - a sustainable instrument for a sustainable future in South Africa. *Environment and Urbanization*, *20*(1), pp.67–87.

Murwirapachena, G., Dikgang, J. and Mulwa, R., 2024. Benchmarking South African water utilities using three efficiency analysis methods. *Applied Economics*, https://doi.org/10.1080/00036846.2024.2364074.

Muyunda, R.N., 2017. *Challenges of local government's water and sanitation provision: A case study of Amajuba District Municipality* (Doctoral dissertation, University of the Free State).

Nakagawa, Y., 2020. Taking a future generation's perspective as a facilitator of insight problem-solving: Sustainable water supply management. *Sustainability*, *12*(3), p.1000.

Nasir, N. and Sukmawati, S., 2023. Analysis of research data quantitative and qualitative. *Edumaspul: Jurnal Pendidikan*, *7*(1), pp.368–373.

Nhamo, L., Mabhaudhi, T., Mpandeli, S., Dickens, C., Nhemachena, C., Senzanje, A., Naidoo, D., Liphadzi, S. and Modi, A.T., 2020. An integrative analytical model for the water-energy-food nexus: South Africa case study. *Environmental Science and Policy*, *109*, pp.15–24.

Nkabane, N.P. and Nzimakwe, T.I., 2018. Sustainable models and framework for enhancing revenue management in municipalities and water service authorities in South Africa. *African Journal of Public Affairs*, *10*(1), pp.113–127.

Noe, R.A., Hollenbeck, J.R., Gerhart, B. and Wright, P.M., 2017. *Human resource management: Gaining a competitive advantage*. New York, NY: McGraw-Hill Education.

Novotny, V., 2014. *Water quality: Diffuse pollution and watershed management*. John Wiley and Sons.

Nurimbetov, R., Khodjaeva, S. and Zikriyoev, A., 2022. Integration of visualizing networks mapping and principal component analyses of digital economic performance in Uzbekistan. *Child Studies in Asia-Pacific Contexts*, *12*(1), pp.410–425.

Oki, T. and Quiocho, R.E., 2020. Economically challenged and water scarce: identification of global populations most vulnerable to water crises. *International Journal of Water Resources Development*, *36*(2-3), pp.416–428.

Pahl-Wostl, C., Knieper, C., Lukat, E., Meergans, F., Schoderer, M., Schütze, N., Schweigatz, D., Dombrowsky, I., Lenschow, A., Stein, U. and Thiel, A., 2020. Enhancing the capacity of water governance to deal with complex management challenges: A framework of analysis. *Environmental Science and Policy*, *107*, pp.23–35.

Parahoo, K., 2006. *Nursing Research: Principles, Process and Issues.* Second Edition. Palgrave Macmillan.

Pascoe, G. Du Plooy-Cilliers, F and Cronje, F in Du Plooy-Cilliers, Davis, C and Bezuidenhout, R., 2014. Chapter 11: *Sampling research matters*. Cape Town, Juta and Company Ltd.

Paterson, M., 2022. *Exploring the role of cooperative governance in water resource management: a study of catchment management agencies in South Africa* (Doctoral dissertation, Stellenbosch: Stellenbosch University).

Patrick, H.O., 2021. Climate change, water security, and conflict potentials in South Africa: Assessing conflict and coping strategies in rural South Africa. In *Handbook of climate change management: Research, leadership, transformation* (pp. 1775–1792). Cham: Springer International Publishing.

Pedroni, J. A. and Pimple, K. D., 2011. A brief Introduction to Informed Consent in Research with Human Subjects. Available: http://pointer.indiana.edu/sas/res/ic.pdf [Accessed on 20 June 2021].

Pietilä, A.M., Nurmi, S.M., Halkoaho, A. and Kyngäs, H., 2020. Qualitative research: Ethical considerations. *The application of content analysis in nursing science research*, pp.49–69.

Pollitt, C., 2015. *The essential public manager*. McGraw-Hill Education (UK).

Poudel, D.D. and Duex, T.W., 2017. Vanishing springs in Nepalese mountains: Assessment of water sources, farmers' perceptions, and climate change adaptation. *Mountain Research and Development*, *37*(1), pp.35–46.

Public Works and Human Settlement, 2019. Human Settlements, Water and Sanitation, Available at: https://www.gcis.gov.za/sites/default/files/docs/resourcecentre/yearbook/Yearbook2020-11-Human%20Settlements%20-Water.pdf (Accessed on 18 April 2024).

Ramcharan, B.G., 2011. The Limburg principles on the implementation of the international covenant on economic, social and cultural rights. In *The Fundamentals of International Human Rights Treaty Law* (pp. 207–222). Brill Nijhoff.

Ramphele, M., 2017. *Are South Africa's National Development Plan's economic growth and employment initiatives sufficiently robust to realise vision 2030? A cross-country analysis* (Doctoral dissertation, University of Pretoria).

Republic of South Africa, 1989. The Environment Conservation Act 73 of 1989. Government gazette, Cape Town.

Republic of South Africa, 1996. Constitution of the Republic of South Africa 108 of 1996. Government gazette, Cape Town.

Republic of South Africa, 1997. Water Services Act of 108 of 1997. Government gazette, Cape Town.

Republic of South Africa, 1998. National Water Act of 36 of 1998. Government gazette, Cape Town.

Republic of South Africa, 2003. Municipal Finance Management Act 56 of 2003. Government gazette, Cape Town.

Republic of South Africa, 2004. The Municipal Property Rates Act (MPRA) 6 of 2004. Government gazette, Cape Town.

Rivett, U., Champanis, M. and Wilson-Jones, T., 2014. Monitoring drinking water quality in South Africa. *Water and Sanitation Africa*, *9*(3), pp.24–29.

Roberts, D. and O'Donoghue, S., 2013. Urban environmental challenges and climate change action in Durban, South Africa. *Environment and Urbanization*, *25*(2), pp.299–319.

Roshan, A. and Kumar, M., 2020. Water end-use estimation can support the urban water crisis management: A critical review. *Journal of Environmental Management*, *268*, p.110663.

Rossouw, J.N., 2015. *Knowledge review of modelling non-point source pollution in agriculture from field to catchment scale*. Water Research Commission.

Ruggiano, N. and Perry, T.E., 2019. Conducting secondary analysis of qualitative data: Should we, can we, and how? *Qualitative Social Work*, *18*(1), pp.81-97.

Ryder, G., 2017. The United Nations world water development report, 2017: Wastewater: The untapped resource.

Salehi, M., 2022. Global water shortage and potable water safety; today's concern and tomorrow's crisis. *Environment International*, *158*, p.106936.

Saravanan, V.S., 2008. A systems approach to unravel complex water management institutions. *Ecological Complexity*, *5*(3), pp.202–215.

Saunders, M., Lewis, P and Thornhill, A., 2007. Research methods. *Business Students 4th edition Pearson Education Limited, England*.

Saunders, M., Lewis, P., and Thornhill, A., 2016. *Research methods for business students*. England: Pearson Education Limited.

Scheba, S., 2022. Viewpoint–The South African Water Sector: Municipal Dysfunction, Resistance and Future Pathways. *Water Alternatives*, *15*(3), pp.632-649.

Schoeman, J., Allan, C. and Finlayson, C.M., 2014. A new paradigm for water? A comparative review of integrated, adaptive and ecosystem-based water management in the Anthropocene. *International Journal of Water Resources Development*, *30*(3), pp.377–390.

Schreiber, J.B., 2021. Issues and recommendations for exploratory factor analysis and principal component analysis. *Research in Social and Administrative Pharmacy*, *17*(5), pp.1004–1011.

Sekaran, U. and Bougie, R., 2016. *Research methods for business: A skill building approach*. John Wiley and Sons.

Semenza, J.C. and Menne, B., 2014. Climate change and infectious diseases in Europe. *The Lancet Infectious Diseases*, *9*(6), pp.365–375.

Serge Kubanza, N. and Simatele, M.D., 2020. Sustainable solid waste management in developing countries: a study of institutional strengthening for solid waste management in Johannesburg, South Africa. *Journal of Environmental Planning and Management*, *63*(2), pp.175-188.

Seward, P., Xu, Y. and Turton, A., 2023. Using back casting to explore ways to improve the national water department's contribution to good groundwater governance in South Africa. In *Groundwater* (pp. 42–58). Routledge.

Shakya, S., Taylor, G.F., Weinhold, M.R., Adams, N.R., Bhattarai, T.N. and Khatiwada, S.B., 2014. Assessment of Water Resources Management and Freshwater Biodiversity in Nepal. *United States Forest Service International Programs Office, Philanthropy Support Services (PSS) Inc. and Nepal Development Research Institute (NDRI)*.

Shaw, I., 2023. Ethics and the practice of qualitative research. In *Research and Social Work in Time and Place* (pp. 277–288). Routledge.

Singh, R. and Mangat, N.S., 2013. *Elements of survey sampling* (Vol. 15). Springer Science and Business Media.

Slevin, E. and Sines, D., 2015. Enhancing the truthfulness, consistency and transferability of a qualitative study: utilising a manifold of approaches. *Nurse Researcher (through 2013)*, *7*(2), p.79.

Stahl, N.A. and King, J.R., 2020. Expanding approaches for research: Understanding and using trustworthiness in qualitative research. *Journal of developmental education*, *44*(1), pp.26-28.

Statistics South Africa, 2019a. Non-financial census of municipalities for the year ended 30 June 2018. Statistical release P9115.

Statistics South Africa, 2019b. General Household Survey (GHS), 2018. Statistical release P0318. Pretoria.

Steyn, M., Meissner, R., Nortje, K., Funke, N. and Petersen, C., 2019. Water security and South Africa. In *Understanding water security at local government level in South Africa* (pp. 1–44). Palgrave Pivot, Cham.

Sürücü, L. and Maslakçi, A., 2020. Validity and reliability in quantitative research. *Business and Management Studies: An International Journal*, *8*(3), pp.2694–2726.

Sutcliffe, C., Knox, J. and Hess, T., 2021. Managing irrigation under pressure: how supply chain demands and environmental objectives drive imbalance in agricultural resilience to water shortages. *Agricultural Water Management*, *243*, p.106484.

Sutherland, C., Hordijk, M., Lewis, B., Meyer, C. and Buthelezi, S., 2014. Water and sanitation provision in eThekwini Municipality: a spatially differentiated approach. *Environment and Urbanization*, *26*(2), pp.469–488.

Tacoli, C., McGranahan, G. and Satterthwaite, D., 2015. *Urbanisation, rural-urban migration and urban poverty*. Human Settlements Group, International Institute for Environment and Development.

Taherdoost, H., 2022. What are different research approaches? Comprehensive Review of Qualitative, quantitative, and mixed method research, their applications, types, and limitations. *Journal of Management Science & Engineering Research*, *5*(1), pp.53-63.

Taherdoost, H.A.M.E.D., Sahibuddin, S. and Jalaliyoon, N.E.D.A., 2022. Exploratory factor analysis; concepts and theory. *Advances in Applied and Pure Mathematics*, *27*, pp.375–382.

Talanow, K., Topp, E.N., Loos, J. and Martín-López, B., 2021. Farmers' perceptions of climate change and adaptation strategies in South Africa's Western Cape. *Journal of Rural Studies*, *81*, pp.203–219.

Taylor, S.J., Bogdan, R. and DeVault, M., 2015. *Introduction to qualitative research methods: A guidebook and resource*. John Wiley and Sons.

Terry, G., Hayfield, N., Clarke, V. and Braun, V., 2017. Thematic analysis. *The SAGE handbook of qualitative research in psychology*, *2*(17-37), p.25.

The South African Human Rights Commission (SAHRC), 2018. South African human rights commission annual report for the year ended 31 March 2018. https://www.sahrc.org.za/home/21/files/Annual%20Report%202018.pdf (Accessed on 12 January 2023).

Thornton, J.A., Harding, W.R., Dent, M., Hart, R.C., Lin, H., Rast, C.L., Rast, W., Ryding, S.O. and Slawski, T.M., 2013. Eutrophication as a 'wicked' problem. *Lakes and reservoirs: Research and Management*, *18*(4), pp.298–316.

Toze, S., 2012. Microbial Pathogens in Wastewater; Literature Review for Urban Water Systems. *Multi Divisional Research Program, CSIRO, Australia, Technical Report*, *1*(97), p.49.

Tsyvinski, A. and Werquin, N., 2017. *Generalized compensation principle* (No. w23509). National Bureau of Economic Research.

Tukura, B.W., Kagbu, J.A. and Gimba, C.E., 2017. Effects of pH and seasonal variations on dissolved and suspended heavy metals in dam surface water. *Chemistry Class Journal*, *6*, pp.27–30.

UNICEF and World Health Organization, 2015. Progress on sanitation and drinking water, update and MDG assessment, 2015.

United Nations International Children's Emergency Fund (UNICEF), 2017. Annual report 2017. https://www.unicef.org/media/47861/file/UNICEF_Annual_Report_2017-ENG.pdf. (Accessed on 12 January 2023).

Vaismoradi, M., Turunen, H. and Bondas, T., 2015. Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing and Health Sciences*, *15*(3), pp.398–405.

Valsalan, J., Sadan, T. and Venketachalapathy, T., 2020. Multivariate principal component analysis to evaluate growth performances in Malabari goats of India. *Tropical animal health and production*, *52*, pp.2451–2460.

Van Beek, E. and Arriens, W.L., 2014. *Water security: putting the concept into practice* (p. 55). Stockholm: Global Water Partnership.

Van der Laan, M., Annandale, J.G., Tesfamariam, E.H., Du Preez, C.C., Benadé, N., Bristow, K.L. and Stirzaker, R., 2017. Modelling nitrogen and phosphorus dynamics in cropping systems at the field scale. *Water Research Commission: Pretoria, South Africa*.

Van Niekerk, H., Silberbauer, M.J. and Hohls, B.C., 2013. Monitoring programme revision highlights long-term salinity changes in selected South African rivers and the value of comprehensive long-term data sets. *Environmental Monitoring and Assessment*, *154*(1), pp.401–411.

Van Vuuren, L., 2009. Counting the lost drops–study into non-revenue water shows we can do more. *Water Wheel*, *12*(1), pp.14–18.

Van Vuuren, L., 2013. Poor and angry-research grapples with reasons behind social protests: water and society. *Water Wheel*, *12*(6), pp.14–16.

Vasileiou, K., Barnett, J., Thorpe, S. and Young, T., 2018. Characterising and justifying sample size sufficiency in interview-based studies: systematic analysis of qualitative health research over a 15-year period. *BMC medical research methodology*, *18*(1), pp.1–18.

Vasileiou, K., Barnett, J., Thorpe, S. et al. 2018. Characterising and justifying sample size sufficiency in interview-based studies: systematic analysis of qualitative health research over a 15-year period. *BMC medical research methodology*, 18, 148

Veriava, A., 2019. Non-revenue water and non-revenue life: A reflection on the making and mitigating of water losses in Johannesburg. *African Studies*, *78*(4), pp.590–608.

Verlicchi, P. and Grillini, V., 2020. Surface water and groundwater quality in South Africa and Mozambique—Analysis of the Most critical pollutants for drinking purposes and challenges in water treatment selection. *Water*, *12*(1), p.305.

Vikas, H., Kini, A., Sharma, N., Gowda, N.R. and Gupta, A., 2021. How informed is the informed consent? *Journal of Family Medicine and Primary Care*, *10*(6), pp.2299–2303.

Viljoen, D.G., 2019. Critical assessment of environmental sustainability reporting using the GRI G4 guidelines: A case study of the South African gold sector. https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&as_ylo=2019&as_yhi=2024&q=municipalities+at+27%25%2C+power+generation+at+2%25%2C+and+mining+at+2%25%2C+among+others+%28Vilijoen+and+van+der+Waly%2C+2019&btnG=(Accessed on 18 April 2023).

Von Bormann, T. and Gulati, M., 2014. The food energy water nexus: Understanding South Africa's most urgent sustainability challenge. *WWF-SA, South Africa*, pp.1–35.

Watkins, M., 2021. *A step-by-step guide to exploratory factor analysis with Stata*. Routledge.

Watson, N., 2014. IWRM in England: bridging the gap between top-down and bottom-up implementation. *International Journal of Water Resources Development*, *30*(3), pp.445–459.

Welman, A.D., 2015. Exopolysaccharides from fermented dairy products and health promotion. In *Advances in Fermented Foods and Beverages* (pp. 23-38). Woodhead Publishing.

Willis, R.M., Stewart, R.A., Panuwatwanich, K., Williams, P.R. and Hollingsworth, A.L., 2014. Quantifying the influence of environmental and water conservation attitudes on household end use water consumption. *Journal of Environmental Management*, *92*(8), pp.1996–2009.

WWAP, 2017. The United Nations World Water Development. Wastewater: The untapped resource. UNESCO/united Nations World Water Assessment Programme, Paris

Ziervogel, G., Enqvist, J., Metelerkamp, L. and van Breda, J., 2022. Supporting transformative climate adaptation: community-level capacity building and knowledge co-creation in South Africa. *Climate Policy*, *22*(5), pp.607–622.

Ziervogel, G., Johnston, P., Matthew, M. and Mukheibir, P., 2010. Using climate information for supporting climate change adaptation in water resource management in South Africa. *Climatic Change*, *103*(3), pp.537–554.

Zuma-Netshiukhwi, G., Stigter, K. and Walker, S., 2013. Use of traditional weather/climate knowledge by farmers in the South-western Free State of South Africa: Agrometeorological learning by scientists. *Atmosphere*, *4*(4), pp.383–410.

Appendices

Appendix 1: Letter of information

Title of the Research Study: Determinants of water service delivery challenges at the Harry Gwala District Municipality.

Principal Investigator/s/researcher: Omega Thuthukile Ngcobo: Master`s Management Sciences in Public Management.

Co-Investigator/s/supervisor/s: Dr Genius Murwirapachena, PhD

Brief Introduction and Purpose of the Study: I am conducting a study entitled “the determinants of the water challenges in the Harry Gwala District Municipality. I am pursuing my Master`s degree in Public Management at the Durban University of Technology registered with the Department of Public Management and Economics. The purpose of this study is to fulfil the requirements of my Master’s Programme.

Outline of the Procedures: The participants will be asked to voluntarily participate in the survey and complete the questionnaires that will be given to them. The participants will be asked to return the questionnaires upon completion. The questionnaires will take approximately 10 minutes to complete whilst the interviews will last between 25 to 30 minutes.

Risks or Discomforts to the Participant: There will be no imaginable discomfort or any risk

Benefits: The information of the findings from the study will be available to all the parties that will be interested in a form of article and publication.

Reason/s why the Participant May Be Withdrawn from the Study: (Non-compliance, illness, adverse reactions, etc. Need to state that there will be no adverse consequences for the participant should they choose to withdraw)

Remuneration: None

Costs of the Study: None

Confidentiality: Anonymity and confidentiality will be ensured, no names of the respondents shall be written on the questionnaires

Research-related Injury: Not Applicable

Persons to Contact in the Event of Any Problems or Queries:

Please contact the researcher on (082 86141 88.), my supervisor (031 373 5198.) or the Institutional Research Ethics administrator on 031 373 2900. Complaints can be reported to the Director: Research and Postgraduate Support Dr L Linganiso on 031 373 2577 or researchdirector@dut.ac.za.

Appendix 2: Informed consent

Faculty of Management Sciences

Department of Public Management & Economics

Statement of Agreement to participate in the Research Study: Determinants of water service delivery challenges at the Harry Gwala District Municipality.

I hereby confirm that I have been informed by the researcher, Omega Thuthukile Ngcobo, about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: _____,

- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during this research which may relate to my participation will be made available to me.

I, _____ (Omega Thuthukile Ngcobo) herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

Full Name of Researcher	Date	Signature
_____	_____	_____

Full Name of Witness (If applicable)	Date	Signature
_____	_____	

Full Name of Legal Guardian (If applicable)	Date	Signature

Appendix 3: Gatekeeper's letter

HARRY GWALA DISTRICT MUNICIPALITY
"Together We Deliver and Grow"
WATER SERVICES DEPARTMENT
40 Main Street, Private Bag X501, IXOPO 3276
Tel: (039) 834 2485 Fax: (039) 834 1701
Email: sihlahlan@harrygwaladm.gov.za

31 March 2022

Ms. OT. Sithole
1684 MorningView
Ixopo
3476

Dear Mrs OT Sithole

PERMISSION FOR MRS OMEGA THUTHUKILE SITHOLE TO CONDUCT INTERVIEWS AT HARRY GWALA WATER SERVICES DEPARTMENT

Harry Gwala District Municipality acknowledge receipt of the letter concerning Mrs Omega Thuthukile Sithole with registration number 20354028 student registered for the Master of Management Sciences in Public Management in the Faculty of Management Sciences at the Durban University of Technology. We highly appreciate her interest in working with Harry Gwala District Municipality in the Water Services Department by conducting a research in her dissertation "Exploring the determinants of water service delivery challenges in the Harry Gwala District Municipality".

We hereby grant permission to collect data from the staff of the water services department. The municipality may request the final research report for its use upon completion of the study.

Yours faithfully

EXECUTIVE DIRECTOR: WATER SERVICES DEPARTMENT
MR D.S GQIBA

Appendix 4: Ethics approval

MANAGEMENT SCIENCES: FACULTY RESEARCH ETHICS COMMITTEE (FREC)

12 August 2022

Student Name: **Ms OT Sithole**
Student No: 20354028

Dear Ms OT Sithole

RECERTIFICATION: MASTER OF MANAGEMENT SCIENCES: PUBLIC ADMINISTRATION

TITLE: Exploring the determinants of water service delivery challenges in the Harry Gwala District Municipality

Please be advised that the FREC Committee has reviewed your proposal and the following decision was made: **Approved – Ethics Level 2**

Date of FRC Approval: 27 November 2019

The Faculty Research Ethics Committee has granted your request for recertification for a period of One year (**From 12 August 2022**), after which you are required to apply for safety monitoring and annual recertification. Please use the form located at the Faculty. This form must be submitted to the FREC at least 3 months before the ethics approval for the study expires.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the FREC according to the FREC SOP's.
Please note that ANY amendments in the approved proposal require the approval of the FREC as outlined in the FREC SOP's.

Yours sincerely

Dr G Murwirapachena
Chairperson: Faculty Research Ethics Committee

Appendix 5: Questionnaires used in the household survey

My name is Omega Thuthukile Ngcobo, a Master's student in the Department of Public Management and Economics at the Durban University of Technology. I am conducting a study on determinants of water service delivery challenges at the Harry Gwala District Municipality. Kindly take some time and answer the questions in this questionnaire as truthful as possible. The questionnaire is divided into three sections. Section A collects some of your personal information for statistical purposes only. Section B contains general questions on water service provision. Section C contains questions on the determinants of water service delivery challenges. Please note that all personal data collected will be treated as strictly confidential.

SECTION A: PERSONAL INFORMATION

1. How many people are in your household?

2. What is your gender? *(Tick appropriate box).*

	Male
	Female

3. **Which racial group do you belong to?** *(Optional)*: *(Tick appropriate box).*

	Black/African
	White
	Indian/Asian
	Coloured

4. What is your marital status? *(Tick appropriate box).*

	Single
	Married
	Other (*specify)*

5. What is your highest education level? *(Tick appropriate box).*

	Never attended formal school
	Primary School
	High School
	Diploma/Degree
	Postgraduate

6. What is your year of birth?

7. What is your household's main source of income? *(Tick appropriate box).*

	Salary/Wages
	Business
	Grant
	Pension
	Allowance
	Other (*specify*)

8. What is your household's monthly average income? (*Tick appropriate box*).

	Less than R2 500 per month
	Greater than R2 500 but less than R5 000 per month
	Greater than R5 000 but less than R10 000 per month
	Greater than R10 000 but less than R15 000 per month
	Greater than R15 000 per month

SECTION B: WATER SUPPLY, RELIABILITY, AND QUALITY

9. What is your household's main source of drinking water? *(Tick appropriate box).*

	Piped water supplied by the municipality
	Borehole water
	River, spring, stream, well etc.
	Other (*please specify*)

10. If water is supplied by the municipality, how does your household receive it? *(Tick appropriate box).*

	Piped water inside the house
	Piped water in the yard
	Piped water from a community tap
	Borehole in my yard
	Community borehole
	Other *(please specify)*:

11. If water is accessed from sources away from your yard, how many minutes on average do you travel on a round trip to fetch water?

12. If water is accessed from shared sources, how many minutes on average do you wait in the queue for your turn to fetch water?

13. How often do you experience water supply interruptions? *(Tick appropriate box).*

	Very often
	Once in a while
	Not at all
	Does not apply to me

14. If you were to indicate the number of times you spend without water supply per month, which of the following best describes your situation?

	About 1 day in a month
	About 2 days in a month
	About 3 days in a month
	About 4 days in a month
	More than four days in a month

15. In general, how long does water supply interruption last every time it happens?

	A few hours
	The whole day
	More than a day but less than a week
	More than a week

16. Does the municipality inform you about water supply interruptions before they happen?

	Very Often
	Occasionally
	Not at all

17. Do you receive updates from the municipality when there are water supply interruptions?

	Very often
	Occasionally
	Not at all

18. Indicate your views on the following statements which refer to the quality of the water you use *(Tick appropriate box).*

	Strongly agree	Agree	Disagree	Strongly disagree
18.1 The water consumed by my household is of good quality				
18.2 Sometimes our drinking water has a bad smell				
18.3 The water we consume sometimes has colour				
18.4 Sometimes the water we consume has a bad taste				
18.5 We always boil the water to make it safe to drink				
18.6 If I pour the water in a glass, I can see some dirt particles				

SECTION C: DETERMINANTS OF WATER SUPPLY CHALLENGES

19. The statements below refer to the possible determinants of water supply challenges. Indicate what you think about each statement (*Please select one answer per row)*

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
19.1 There is too much political interference which causes water supply challenges in the municipality					
19.2 Illegal water connections play a part in water supply challenges in the municipality					
19.3 The municipality does not have enough funds to supply water effectively					
19.4 Water supply challenges are mainly due to the mismanagement of funds by the municipality					
19.5 Water supply challenges are because the municipality does not include communities in decision making					
19.6 Corruption is among the main causes of water supply challenges					
19.7 Industries are affecting the quality of water through pollution					
19.8 Mismanagement of wastewater (sewage) is affecting the water quality in the municipality					
19.9 Water pipes are too old that they burst often.					
19.10 Activities like pipe theft by some community members affect water supply					
19.11 Water tariffs are too low that the municipality cannot raise enough revenue to sustain water supply					

19.12 Residents who can afford to pay for water services usually refuse to do so					
19.13 Most residents are poor and receive water for free					
19.14 The municipality does not regularly maintain water infrastructure					
19.15 The municipality takes too long to solve water supply problems					
19.16 The municipality does not have enough qualified personnel					
19.17 Community members have no interest in participating in activities on water supply that are organised by the municipality					

Thank you for taking your time to answer this questionnaire.

Appendix 6: Interview guide

DETERMINANTS OF WATER SERVICE DELIVERY CHALLENGES AT THE HARRY GWALA DISTRICT MUNICIPALITY

My name is Omega Thuthukile Ngcobo, a Master's student in the Department of Public Management and Economics at the Durban University of Technology. I am conducting a study on determinants of water service delivery challenges at the Harry Gwala District Municipality. Kindly take some time and answer the questions in this questionnaire as truthful as possible. The interview is divided into two sections. Section A collects some of your personal information for statistical purposes only. Section B contains general questions on water service provision and contains questions on the determinants of water service delivery challenges. Please note that all personal data collected will be treated as strictly confidential.

1. Kindly tell me more about yourself

   Probes:

   a) Your gender……

   b) Your position in the Municipality……

   c) Your years of experience in the municipality……

   d) Years of experience in the Water Service Department…….

   e) Your age…….

   f) Level of education…….

2. Please tell me about water service delivery in the municipality.

   Probes:

   a) What are the main water service delivery challenges in the municipality?

   b) What do you think are the key drivers of the challenges you have explained?

   c) In your own opinion, how do you think the municipality can successfully respond to these challenges?

Thank you for taking your time to answer this interview guide

Appendix 7: Proof of language editing

Sury Bisetty Academic Editing Services

CIPC No. 2021/360666/07

The pen is mightier than the sword

To whom it may concern

I edited the thesis titled: Determinants of water service delivery challenges at the Harry Gwala District Municipality by Omega Thuthukile Sithole, student number 20354028, submitted in fulfilment of the requirements of the degree of Master of Management Sciences in Public Administration in the Faculty of Management Sciences at the Durban University of Technology.

Sury Bisetty Date: 22 July 2024

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Disclaimer: I provided language and technical editing as per discussion with the client. The content and structure of the thesis were not amended in any way. The edited work described here may not be identical to that submitted. The author, at his/her sole discretion, has the prerogative to accept, delete, or change amendments/suggestions made by the editor before submission.
My editing adds tremendous value to your document, but I am only human. Although I rigorously check and recheck my work, it is impossible to guarantee 100% perfection.