Identifying the Factors that affect the Provision of Water to Households in the Free State Province

By

Lucky Isaac Lukhele

Student No: 20001142

Supervisor: Prof I Kaseeram

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ABSTRACT

The deterioration of water infrastructure leads to a reduction in economic growth and poor health for the citizens. Decision makers in local government prefer to prioritise above ground infrastructure and neglect critical underground infrastructure issues such as maintenance of water pipelines. As a result, this study used archival data to investigate the factors that increase the probability of water supply disruptions in the Free State Province. It also used a survey questionnaire to assess the perceptions of senior municipality officials involved in the water division with regards to the causes of frequent water disruptions. The study found out that poor maintenance, ageing infrastructure and low dam levels and a high proportion of poor households increase the probability of frequent water disruptions.

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LIST OF ACRONYMS USED

AI - Ageing infrastructure

AWD – Amount of water in dams

GD – Grant disbursement per town

IBT – Increasing block tariff

INRDP– informal households on RDP level

LIH – Number of low income households

LIPP – low income households as a percentage of the population

LIPP –Low income as percentage of population

MDG – Millennium Development Goals

MWS – Maintenance of water system

NDP – National Development Plan

NWRS- National Water Resource Strategy

OECD – Organisation for Economic Co-operation and Development

OECD- Organization for Economic Cooperation and Development

PPF– Production Possibilities Frontier

PPP – Public Private Partnership

PWID – Piped water inside dwelling

QED – Quality of effluent discharge

QWD – Quantity of water demanded

RDP – Reconstruction and Development Program

SIWI – Stockholm International Water Institute

SPSS – statistical package for social science

THBRDPS - total households below RDP level on sanitation

UNEP – United Nations Environment Programme

USA – United States of America

WL – Water loss

WSC – Water storage capacity

CHAPTER ONE

1.1 INTRODUCTION

The delivery of water services is vital for health purposes, economic stability and overall social well-being. Politicians, however, tend to favour visible projects such as over ground infrastructure at the expense of less visible projects such as water infrastructure development (Batley and Mcloughlin, 2015). According to Heleba (2009), many urban areas have unreliable water pipes and unaccounted connections, and encounter supply disruptions as well as numerous leakages. Ginster *et al.,* (2013) are of the view that municipalities play a role in increasing water losses through poor maintenance of infrastructure. Batley and Mcloughlin (2015) observe that municipalities usually prioritise the setting up of new infrastructure at the expense of investments in maintenance or recurrent costs. Nonetheless, Ginster *et al* (2013) argue that there are other factors, such as ageing infrastructure, leakages and cable thefts that have been causing water supply problems in places such as Brandfort in the Free State.

Jordan and Wyatt (1989) note that the cost of the maintenance of infrastructure should be estimated well. This ensures that there will be enough funds for operation and maintenance and the community affords the associated charges. According to van Zyl (2014), appropriate operation and maintenance ensures sustainable service provision. Operation here, involves the monitoring of the state of the system, administration of the system and ensuring compliance. While maintenance is about condition assessment, restoration servicing and replacement of system components is also important.

An increase in water supply infrastructure means more water for businesses and that of the amount of water dependent goods that can be manufactured by the economy (Schwartz and Johnson, 1992). Mokonyane (2017) notes the National Development Plan supports the idea of partnerships between public and private sector players. The role of public-private partnerships in service delivery and financing of water supply and sanitation infrastructure is critical. Naidoo (2017) notes South Africa is better than Africa in general when it comes collective action

between the public and the private sector. However, there is still a need to build trust between the two sectors.

Population growth and reduction of household size makes it difficult to achieve water connections for all households (Banerjee *et al.,* 2008). Current estimates for infrastructure needs and investments over a 10 year period in South Africa vary from R330 billion to more than R1 trillion when including infrastructure maintenance, upgrades and planned initiatives (Mokonyane, 2017).

In addition, rising income is associated with water infrastructure coverage (National Treasury, 2011). However, some Africa countries, such as Nigeria, have high incomes but low infrastructure coverage (Sanctuary *et al.,* 2004). The poor have little economic capacity to invest in environmental infrastructure such as tanks, piped water and flash toilets (Tanyanyiwa and Mutungamiri, 2011). South Africa, in particular, has a plan in support of the service provision for the poor; however, there are still people who are without services in the poorest districts and some rural areas in the country (Heleba, 2009).

According to Rhodes and McKenzie (2015), better quality of water and sanitation is associated better health outcomes. Whittington and Hanemann (2006) note poor water and sanitation place macroeconomic risks for trade, investment, travel and tourism.

1.2 PROBLEM STATEMENT

Many towns and cities are still faced with unreliable piped water systems, with water supply disruptions, high leakage rates and water loss. Water Services Authorities are not doing enough operation and maintenance of infrastructure in the Free State. Water Losses are also very high and the exact amount of water loss is unknown (Ginster *et al.,* 2013). Every week in the Free State Local Municipalities, there are many communities that experience water supply interruptions in their different areas. In addition, the drought has reduced the amount of water for consumption in the Free State.

Ginster *et al.,* (2013) observe disruptions in water supply impact negatively on the provision of healthcare at clinics and hospitals and on the schools feeding schemes for poor communities. The severity of the impact of the infrastructure failure was noted in the discontinuation of feeding schemes because of lack of water and the closure of the local clinic, a modern building complex in Brandfort, owing the absence of water. Water supply problems also negatively affect the sales of houses located in the elevated regions. Tempelhoff *et al.,* (2012) observe that water disruptions impact negatively on the tourism sector and the economy.

There are no studies that focus on the entire Free State Province with regard to disruptions in water supply. Most studies focus on specific towns where there are relatively frequent water supply crises. This study aims to fill that gap but goes further than mere survey questionnaires and employs the latest available archival data in quantitate analysis.

1.3 RELEVANCE AND JUSTIFICATION OF THE STUDY

There have been many service delivery protests in South Africa and these protests appear to be increasing with each year. The protests arise from poor communities' complains about poor service delivery of water, electricity, sanitation and housing by the local government. Here, communities often choose violent mass action (Pretorius and Schurink, 2007).

Algotssom *et al.,* (2009) note that the Water Service Acts and Strategic Framework for Water Services delineate the powers, functions and duties of Public service delivery. These powers, functions and duties include the provision of physical infrastructure, good governance and social programmes that address underdevelopment and inequality and thereby create prosperous communities.

1.4 AIMS AND OBJECTIVES OF THE STUDY

The aim of the study is to investigate the factors that cause water supply disruptions in the Free State Province. The objectives are as follows:

(i) The first objective is to ascertain the perceptions of senior municipality officials working in the water division of Free State Towns with regard to causes of frequent water disruptions.

(ii) The second objective is to identify factors that can assist in predicting the probability of the increase in frequency of water supply disruptions.

The following sub-objectives may be identified from these objectives:

1) To assess whether poor maintenance is associated with frequent disruptions on water service delivery.
2) To assess whether Water Storage Capacity has a correlation with frequency of disruption in water supply.
3) To establish whether the amount of grant disbursements per town have an association with whether there is frequent water disruption or not.
4) To investigate whether the number of poor households is not linked to whether there is frequent water disruptions or not.
5) To establish whether the number of households in a municipality have an association the frequency of water disruptions or not.
6) To determine whether ageing infrastructure has a relationship with frequent disruptions in water service delivery.
7) To assess whether an infrastructure backlog has a relationship with frequent disruptions in water service delivery.
8) To investigate if the quantity of water demanded is associated with the frequency of water disruptions or not.
9) To find out whether the amount of water demanded in litres per capita per day has a relationship with the frequency of disruptions.
10) Establish whether the amount of households having piped water inside a dwelling is linked to the frequency of water supply disruptions.
11) To assess whether the number of female-headed households in a town is an effective predictor of the frequency of water supply disruptions.

12) To investigate whether the quality of discharged effluent can serve as a predictor of water supply disruptions.
13) To establish whether the water level in dams is associated with frequency water supply disruptions.
14) To determine if the amount of water loss in a municipality is linked to the frequency of water supply disruptions.
15) To investigate whether low income households as a percentage population in a municipality can serve as a predictor of the frequency of water supply disruptions.
16) To assess whether the high density of informal households on RDP level in a municipality is a suitable predictor of the frequency of water supply disruptions.
17) To ascertain if the total number of households below the RDP level on sanitation can be associated with frequent water disruptions.

1.5 INTENDED CONTRIBUTION TO THE BODY OF KNOWLEDGE

This research is the first which investigates the factors that are associated with water supply interruptions in the Free State Province. There are no studies that focused on the entire Free State Province with regard to disruptions in water supply. Most studies focus on specific towns where there are water supply crises. These studies include Ginster *et al.,* (2013) who investigated water supply disruptions in Brandfort in the Free State and Tempelhoff *et al.,* (2012) who investigated a similar problem in Carolina, Mpumalanga. This study aims to fill that gap.

1.6 RESEARCH QUESTIONS

In the light of the aims and objectives mentioned in section 1.8 above, the following research questions were formulated:

(i) What are the perceptions of Free State senior municipality officials working in the water division with regard to the linkage to frequent water disruptions?
(ii) What factors can assist in predicting the association of increase in frequency of water supply disruptions? Stemming from this research question the following sub-questions may be identified:

1) Is poor maintenance linked frequent disruption in water service delivery?
2) Does poor water storage capacity have an association with the frequency of disruptions in water supply?
3) Is the amount of grant disbursement per town linked to the frequency of water disruptions?
4) Is the number of poor households linked to whether there are frequent water disruptions or not?
5) Does the number of households have linkage with frequent water disruptions or not?
6) Does an ageing infrastructure have positive relationship with frequent disruption in water service delivery?
7) Is infrastructure backlog linked to disruptions in water service delivery?
8) Does the quantity of water demanded have positive relationship with frequent water disruptions or not?
9) Does the amount of litres per capita per day have a linkage on whether there are frequent water disruptions or not?
10) Is the amount of households having piped water inside a dwelling linked to whether there are frequent water disruptions or not?
11) Is the amount of female-headed households linked whether there are frequent water disruptions or not?
12) Does the quality of effluent discharged have a correlation on whether there are frequent water disruptions or not?
13) Does the amount of water in dams have a correlation on whether there are frequent water disruptions or not?
14) Does the amount of water loss have a correlation on whether there are frequent water disruptions or not?
15) Do the low income households, as a percentage population, have a correlation on whether there are frequent water disruptions or not?
16) Does the number of informal households on RDP level, as a percentage of the population having access to water, have a correlation on whether there are frequent water disruptions or not?

17) Is the total number of households below the RDP level on sanitation associated with frequent water disruptions?

1.7 METHODOLOGY

Quantitative data was collected from secondary sources in the electronic databases and the archival records of the various municipalities in order to address the second objective. In particular, the data was clustered under poor maintenance, number of poor households, water loss and ageing infrastructure in the Free State Province. These factors were then entered in the logistic model explanatory variables to predict the dichotomous variable represented by the absence (coded 0) or presence of frequent water supply (coded 1) disruptions to a particular municipality. In addition, and in order to address the first objective qualitative and other quantitative, data was collected through the use of a questionnaire that was administered to a minimum of 2 key informants (high ranking administrators, water engineers and other technicians) from the 20 municipalities regarding the factors that are associated with water supply disruptions. Prior to the collection of data, an ethical clearance certificate from the University of Zululand's Ethics Committee was obtained as stipulated in the research policy guidelines of the university.

1.8 ETHICAL AND SAFETY ISSUES

The University of Zululand research policy guidelines state that any researcher intending to conduct any human or animal-related research is required to apply for an ethical clearance certificate, which is granted after consideration of the ethical and safety issues of the proposed study. For this study, the researcher obtained the certificate (refer to appendix A) and the field work commenced.

The respondents were not required to fill in their personal details; only their signature was required. The respondents were assured of confidentiality and anonymity. They were also made aware that the filling in of the questionnaire was voluntary and that they could choose to opt out

from participating in the research at any time should they wish so. Additionally, this dissertation was subjected to the turn-it-in software in order to avoid the possibility of plagiarism.

1.9 CONCLUSION

This chapter outlined the introduction. It presents the problem statement, the relevance and justification of the study, the aims and objectives of the study, the intended contribution of the study to the body of knowledge, research questions, methodology, and the ethical and safety issues.

CHAPTER 2

2. THEORETICAL LITERATURE REVIEW

2.1 INTRODUCTION

The provision of water is critical for health, economic stability and overall social well-being. Politicians, however, tend to favour visible projects such as the construction of buildings and roads at the expense of projects such as water infrastructure development (Batley and Mcloughlin, 2015). At the same times, high provider autonomy increases the power to providers, contractors and stuff than to politicians, policy-makers, managers and users (Batley and Mcloughlin, 2015). The citizens' influence on the provision of particular services, such as water and sanitation, may be limited because of the asymmetry of information (Dollery 2003). In addition, lack of a political voice may prevent rural or urban poor from having their needs heard (Bosch, Hommann, Rubio, Sadoff, and Travers, 2002).

Furthermore, water supply systems are capital intensive and promote monopoly profits rather than the public welfare (Whittington and Hanemann, 2006). Citizens' well-being is affected by the absence of water provision. Lack of water at home forces household members to use water from other sources, including unprotected rivers, canals and lakes (Meeks 2012). Households risk their lives by drawing on such unprotected sources (Bosch et al., 2002). As a result, technical, operational and leadership skills are very important for the delivery of water and sanitation (Pretorius and Schurink, 2007).

Larger local authorities are normally the most economically efficient while smaller councils benefit from the political advantages (Dollery, 2003). The citizens' welfare can be maximised through the provision of water at a marginal cost with water being used to a point where the marginal cost is equivalent to the marginal benefit (Perry, Rock, and Seckler, 1997). This will result is a number of positive results. For instance, Water and Sanitation investment increases the gross domestic production and national income. In addition, an efficient water use maximises economic growth, while the construction of water infrastructure increases the demand for other factors of production. Finally, investment in water supply and sanitation results in job creation and increased rates of employment.

Therefore, this chapter reviews literature that focuses on infrastructure and growth, water supply, employment, water quality and cost and the production possibilities frontier. The chapter also focuses on issues such as the maintenance of water infrastructure, skills and maintenance, the disruption in water infrastructure, repairable and non-repairable systems, the cost related to infrastructure maintenance, sustainable water supply, the capital water intensive infrastructure, the political management of service delivery, information asymmetry, bureaucratic discretion and its impact on political power, the public private partnership, accountability in service delivery and voice of the citizens, leadership, water supply for the poor, female headed households, education for households, sanitation supply, public, merit and private goods, market failure, efficiency in the delivery of services and the demand for water, the cost for water, decentralization, the general service delivery, agriculture water use and drought.

2.2 INFRASTRUCTURE AND GROWTH

In this subsection an attempt is made to draw the link between infrastructure provision, health and well-being of citizens and its relationship to economic growth.

Infrastructure is defined as a part of capital goods that are not consumed directly but offer services in conjunction with labor and other inputs. The public sector infrastructure sometimes benefits from private sector capital investment. Public capital requires state action and investment in dams, bridges, roads, highways dams, ports, airports, water supply networks and sanitation, environmental protection systems, hospitals and other publicly-provided productive forms. Infrastructure provides the services that people require and want and these include water and sanitation services, access to telephone and computer networks, and transport services. Therefore, the development of the infrastructure stock reduces poverty and increase national wealth (Fronea and Froneb, 2014).

The production potential and efficiency is dependent on the health of the citizens and reliable water supply. Reduction in poverty, promotion of health, growth of income, promotion of gender equality and management of sanitation are requires water services. Both public and private sector

are required in order to expand water and sanitation. Better economic, health and education means increase in output and efficiency of labour (Sanctuary, Tropp and Berntell, 2004). Economic growth likewise encourages the growth of investments in water management and services. According to the NWRS (2013), infrastructure such as dams, enables reliable supply of water, and increases the quantity of water available for use by storing water that would have run into the sea. The SIWI (2004) also states that water infrastructure is an important component of economic growth, water resources management and the provision of access to water and sanitation. Dams and reservoirs offer services such as flood control, power generation, and water supply for domestic and agriculture users. Without adequate water control infrastructure, the economy becomes more vulnerable to water-related problems such as reduction in rainfall. Water resources management, water supply and sanitation contribute meaningfully to the improvement of production and productivity in the other economic sectors. The provision of reliable and sufficient water supply is critical for business development, reduces investment risks and appeals to investors. Thus, there is need for public and private investment that improves water, sanitation and water resources management (Sanctuary et al., 2004).

There are a number of benefits that can be obtained from improved water supply and sanitation and water resources management. Water resources are important for production and productivity. Thus, any interventions seeking to decrease poverty and boost economic growth should consider the health, livelihood system and resilience to rainfall variability (Sanctuary et al., 2004). Infrastructure can have negative and positive impact through growth complementarity and crowding out effects. Infrastructure encourages economic growth complementary by private capital formation. Crowding out means that, in the short run, a rise in public capital stocks can shift or crowd out private investment. Such an undesirable crowding out effect on infrastructure can turn into a long-term undesirable impact if the reduction of private capital formation continues into long term (Dissou and Didic, 2013). The maintenance of good public infrastructure certainly influences growth by improving the longevity of private capital. Improving government infrastructure maintenance expenditure causes the private sector to spend less in maintaining its own capital and therefore the investment capacity can be allocated to other usages, thereby making an additional growth outcome.

Dissou and Didic (2013) observe public infrastructure increases the marginal productivity of private inputs. This increases the rate of return of private capital and increases private sector demand for physical capital. According to Fronea and Froneb (2014), there are various impacts of infrastructure on economic growth. These are: infrastructure decreases the price of inputs in the production process, it infrastructure enhances workers' labour productivity; infrastructure creates jobs, infrastructure increase education and health outcomes. Agenor and Moreno-Dodson (2006) have the same view with regard to productivity, health and education outcome. Nonetheless add that public infrastructure may influence economic growth through: enabling adjustment costs linked with private capital formation and its mobility to comparatively more profitable actions and increasing the longevity of private capital

A development strategy for a country and macroeconomic policies, such as fiscal, trade and monetary policies are affected by the demand for and investment in water-related activities. Widespread water-related diseases or illnesses impact negatively on investment at macroeconomic level (Sanctuary et al., 2004). The direct productivity arising from infrastructure investment shows the positive effects derived from public capital stock and their role in reducing influence on the marginal product of factor inputs like capital and labour (Dissou and Didic 2013). An increase in the productivity of rural workers in developing countries leads to an increase in private demand for workers. Increased economic growth is very important for poverty reduction. Poverty has psychological problems that include powerlessness, voiceless, shame, dependency and humiliation. Poor people have basic infrastructure such as roads and clean water. Education assist in escaping poverty only if the economic environment improves and the quality of education improves (Nafziger, 2012). In addition, economic growth is critical towards reaching quantity objectives that include increased water and sanitation coverage (Whittington and Hanemann, 2006). Therefore, the way water is managed plays an important role on the production and consumption of ecosystem services and goods such as fish, fuel, timber, food crops, medicine and pasture (Sanctuary et al., 2004), as well as the nature of the particular country's economic growth.

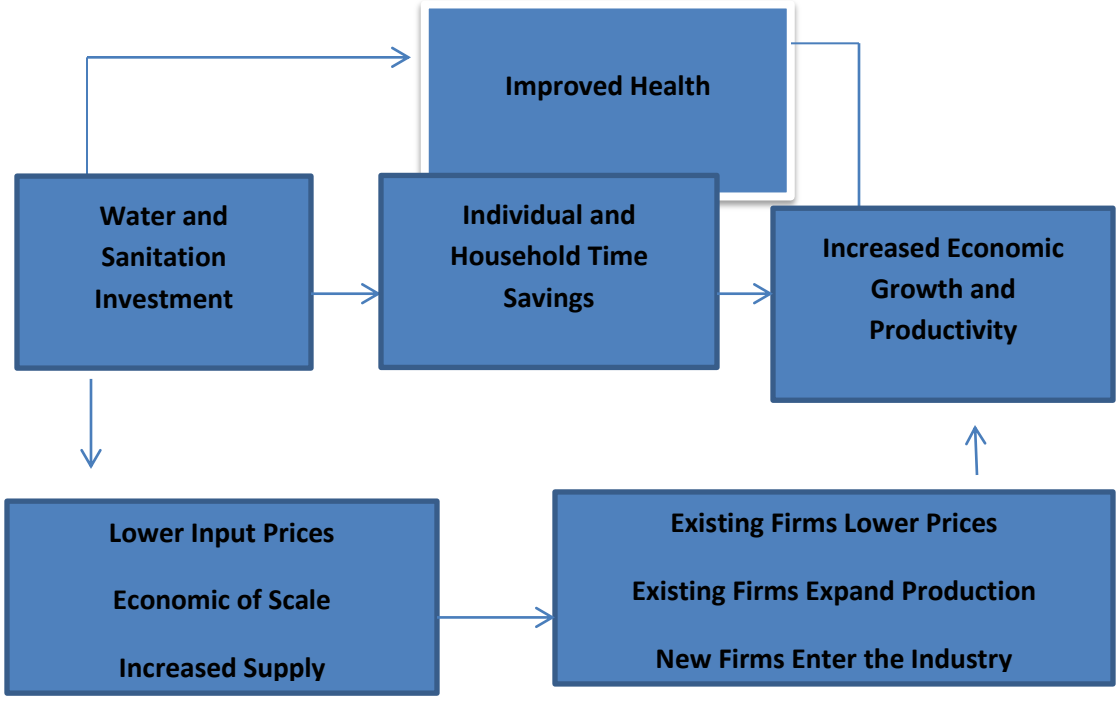
Public capital, particularly the infrastructure capital, is critical for the household and business' economic and social activities. Public infrastructure is a public good sponsored by public saving

that is not typically traded on international markets. Public investment related to the development of infrastructure and provision of public goods can be complementary to and not competing with private investment. Public investment increase aggregate economic activity and saving. The impact of infrastructure investment on development is critical for government policy and the strategic development of a country, particularly during recession or economic transition. Therefore, the development of the infrastructure stock has a direct effect on reducing poverty and raising national wealth (Fronea and Froneb, 2014). In addition, public infrastructure is a prerequisite for national and regional economic growth and a channel through which private enterprises invest in developing countries. Infrastructure affects productivity and output directly by enlarging the size of the product and labour markets. Infrastructure is good for pro-poor growth as it enhances total growth, and inspires the participation of poor people in the growth process and thus reduces income inequality (Banerjee, Wodon, Diallo, Uddin, Tsimpo and Foster, 2008).

Investment in water and sewer infrastructure has lower long term elasticity than all other types of infrastructure except for highways and streets (Krop, Hernick and Frantz, 2008). According to Nafziger (2012), the important measure is the elasticity of pro-poor growth, a percent rise in the consumption growth of the poor to the percentage rise in the consumption growth of the non-poor. If the elasticity is more than 1, then the procedure is pro-poor while less than 1 elasticity is considered as anti-poor. Regional elasticity for Sub-Saharan Africa, South Asia and Middle East is less than 1.

Diagram 1 below shows the influence water and sanitation on improved health, input prices, time saving, growth and productivity and other economic indicators.

Diagram 1: Economic benefits of Investment in Water Supply



Source: (Schwartz and Johnson, 1992)

Hence, expenditure distribution that supports education, health and infrastructure, enhances economic growth while encouraging equity and reducing levels of poverty (Alabi, Adeolu, Adams, Ojor, Chime, Chinyere, Abu, Omokhefue and Alguomudu and Ebehimerem 2010).

2.3 WATER SUPPLY, EMPLOYMENT, WATER QUALITY AND COST

This subsection demonstrates the challenges of ensuring high quality water supply at the marginal social cost, the necessity of vital water infrastructure and its relationship to a well-functioning economy. Inadequate infrastructure is a limiting factor in poverty alleviation and economic recovery (Ivanyna and Shah, 2014). The reality that most new jobs originate from small firms suggests that a poor water supply delays the generation of employment and income. On the contrary, there are high returns for selectively improving the water supply and other services users at specific locations (Schwartz and Johnson, 1992). Lower costs of production also lead to the expansion of existing industries and emergence of new ones. Economies of scale, density economies, and technical efficiency reduce costs (Schwartz and Johnson, 1992).

Investment in water and sanitation may improve the water supply for the commercial and industrial sector through system development or the rehabilitation of the distribution network in order to decrease water loss. Second, investment can provide new or enhanced supplies of water and inspire the formation of commercial and industrial enterprises by removing main constraint on production (Schwartz and Johnson, 1992). The investments are expected to bring about a reduction in the price of water and an enhancement in quality. The expected behavioral reaction by firms will be to increase output and profits. The more competitive the market, the lesser the probability for firms to hold production constants and increase profits (Schwartz and Johnson, 1992).

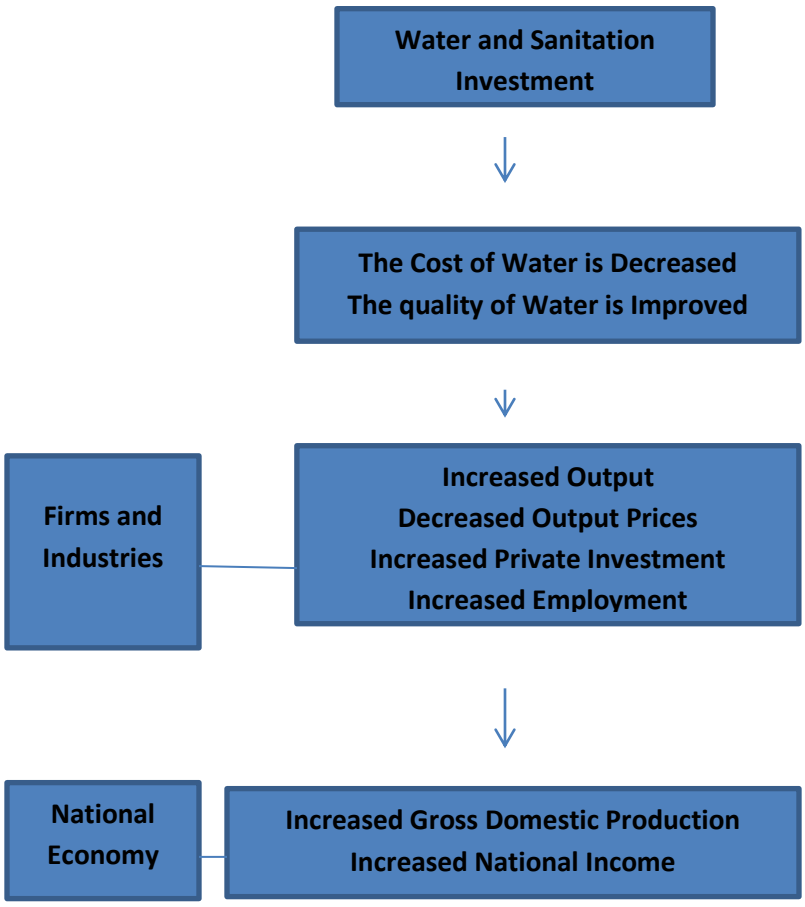
Investment in water and sanitation improves the demand for all the factors of production, including labour. It has been observed that an investment in water and sanitation causes job creation and higher rates of employment, which underscores employment generation as an essential component in water and sanitation investment. Infrastructure, such as water, drainage, and streets, is perceived by manufacturers as an important precondition for financial capital and legal services. As a result, factors such as poor roads, insufficient electricity, and distance from markets obstruct expansion, while the obtainability of water affects business investments (Schwartz and Johnson, 1992). According to the NWRS (2013), infrastructure development creates jobs. Here, direct job creation occurs as a result of the development, operation and management of water infrastructure. There are other indirect job creation movements that link water supplies with economic activities such as manufacturing, mining, power generation and agriculture. Therefore, investment in infrastructure development creates employment opportunities for local workers and offers skills development and work experience at a number of levels, from the highly technical jobs to manual labour.

The quality of available water is very important. Pollution affects water availability through its impact on the quality of surface water and groundwater (Jansen, 2012). Water scarcity and pollution limit economic activity, reduce fisheries and increase the cost of providing water. Rotten garbage and blocked drains contribute to the pollution of ground water. Balint also notes that an improper disposal of infected excreta leads to the contamination of soils, surface waters,

and ground water. Furthermore, poverty and insecurity contribute to lack of resources earmarked for the conversation of the environment (Nafziger, 2012). Water and sanitation affect the quality and cost on firms and industries, and the national economy as shown in Diagram 2. The cost of water is reduced through water and sanitation investment and water quality is improved through water and sanitation investment. In addition, water and sanitation attract private investment and create employment and ultimately lead to an increase of the GDP and national income.

Diagram 2 shows the effect of water and sanitation investment on firms and industries and the national economy.

Diagram 2: Water and sanitation investment



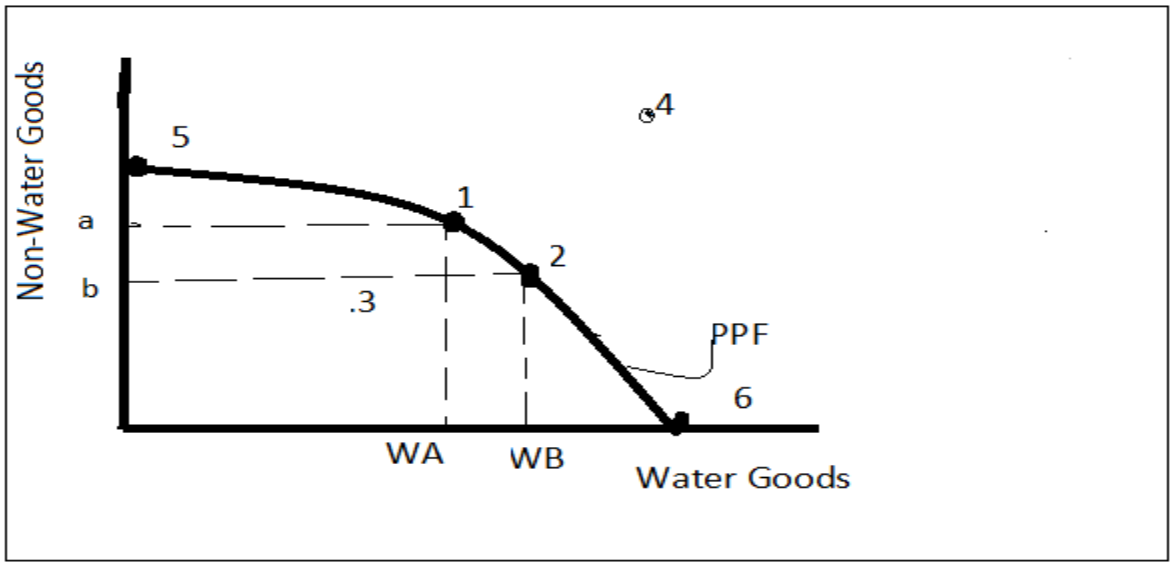
Source: Schwartz and Johnson. 1992

2.4 THE PRODUCTION POSIBILITIES FRONTIER

The production possibility frontier is a useful framework to demonstrate water supply, service delivery and investment in water and sanitation infrastructure and services within the context of the macro-economy, which the following review attempts to achieve.

The restraining influence of an inadequate or inefficient water supply on commercial and industrial use can be defined in terms of a production possibilities frontier. The production possibilities frontier is the maximum quantity of goods and services that can be produced by an economy when all obtainable resources are fully used. Goods and services can be divided into two groups: water goods that need water as a direct input in production; and non-water goods that do not directly need water in production (Schwartz and Johnson, 1992). Water goods range from those that require a fairly large volume of water for production to those that use a much lesser volume of water. Non-water goods consist of items like furniture. A national economy can be described along production possibilities frontier for water goods and non-water goods. Points along the PPF curve, such as 1 and 2 reflected in Diagram 3, signify all the possible combinations of Water Goods and non-water goods that could be produced by the economy while using all available resources.

Diagram 3: Production Possibility Frontier of Water and Non-Water Goods



Source: (Schwartz and Johnson. 1992)

Point 3, shows a package of water goods and non-water goods when the economy's available resources are under used. This arises when water is lost through leakages and illegal taps. Such problems may be associated with poor management and monitoring systems, lack of funds for the replacement of old infrastructure, lack of skills resulting in poor maintenance. According to Garcia-Valinasa et al., (2009) economies with frequent water supply disruptions may also be categorised as operating at point 3 on the above PPP. At Point 4 shows a mixture of production that cannot be reached by the economy with its available resources. Point 6 on the curve shows the highest quantity of water goods that can be produced if only water goods are made. Point 5 represents the highest quantity of non-water goods that can be produced if they are the only ones that are produced. The location of the frontier is relatively influenced by the water supply infrastructure obtainable in the economy. A rise in the production of water goods beyond Point 6 is not attainable without increase in investment of water supply infrastructure (Schwartz and Johnson, 1992).

Even variations in the mixture of goods along the frontier toward more production of one type of product come by reducing the output of the other. Still on diagram 3, a flow from Point 1 to Point 2 would rise the output of water goods (from WA to WB) but reduce the output of non-water goods (from a to b). Resources like land and labour that are used in the making non-water goods would have to be moved to the production of water goods (Schwartz and Johnson, 1992). Increase in water supply infrastructure encourages growth in the national economy which in turn will cause additional rounds of infrastructural capital investment. Capital stock investment delivers extra water for commercial and industrial which move the production possibilities frontier outward. Hence, production possibilities that were unachievable prior the investment in water supply, like Point 4, would then be reachable. If the new capital investment is from prudent tax funds for sustainable public investment (see, Agenor and Moreno-Dodson, 2006) or external donor or private sources, the production possibilities curve simply moves outward. Outward change in the production possibilities frontier is also cause by an investment that raises the technical and economic efficiency of existing water supply inputs. Barbier (2004) asserts that socially efficient water utilisation that increase economic growth does not only require public but also private sector investment for privatisation, pricing reform and water markets all have the potential for establishing the inducements for a more efficient use of water in the economy,

thereby moving the frontier outward, than simply depending on public sector water management alone.

2.5 MANTAINTANCE OF WATER INFRASTRUCTURE

A water supply infrastructure around the world is deteriorating. The water industry is faced with the challenge of managing deteriorating water infrastructure and how to maintain current and future service levels (Watson et al., 2001). As a result, this section considers the benefits of maintenance, outlines the nature and types of maintenance and discusses the difference between the operation and maintenance of water infrastructure. Also examined here are the long term and short-term maintenance.

Maintenance has a multipurpose and significant role with regard to the management of infrastructure. It entails situation assessment, repair servicing and replacement of system components (van Zyl, 2014). It also prevents failures and restores the functioning of infrastructure after the occurrence of failure. Maintenance preserves the infrastructure reliability and operation regularity. Maintenance classically involves repair, rehabilitation and renewal. As a result, most maintenance policies focus on renewal decisions by means of planned pipe replacements that are grounded by engineering decision and knowledge of the infrastructure (Watson, Christian, Mason and Smith, 2001). Any water distribution system is meant to deliver an adequate and reliable supply of safe water to its consumers, thus making actions related to operation and maintenance critical towards continuously fulfilling the objective of a water distribution system. It should, however, be stated that there is a difference between operation and maintenance in that operation involves activities, such as the monitoring and running of the system and the enforcement of policies and procedures required for the provision of the service, whereas maintenance comprises activities that preserve the system in decent working condition.

van Zyl (2014) notes there are a number of maintenance categories, with their particular significances, which can be used to take care of infrastructure. Maintenance that is done before a system part fails and to avoid it from failing is referred as proactive maintenance, while that done after a part failure is called reactive maintenance. Ginster et al., (2013) observe one of the major

causes of disruption in water supply in the Free State Province's townships was lack of proactive maintenance and aging infrastructure. van Zyl (2014) adds operation and maintenance of a water distribution system can be greatly affected by the system design and construction practices used. For instance, a design that specifies unsuitable pipe materials or pipes that are damaged during construction may lead to major future operation and maintenance problems for the system (van Zyl, 2014). Nonetheless, maintenance planning is divided into short-term at 1 to 2 years and long-term at 5 or more years. Long term planning attempts to estimate the overall projected annual costs centered upon the estimated asset lifetimes and yearly percentage renewal rate. This guarantees that the normal replacement age of a pipe is the same to the estimated lifetime. This process is revised each five years and incorporated into the Strategic Asset Management Plan, while short term planning is completed on an annual basis and incorporated in the Annual Asset Management Plan (Watson et al., 2001).

Appropriate operation and maintenance are essential towards ensuring that capital investments on new infrastructure result in sustainable service provision. The lack thereof might mean that a new water distribution system will soon drop to a point where service provision is compromised, leading to greater water and financial losses and health risks to consumers. The neglect of operation and maintenance for a long period of time may result in the need to replace the system, a process requiring a new injection of capital that could otherwise have been used for other needs or cater for economic development. As a result, maintenance principles are critical and these involve condition monitoring, and means to offer protection to the system environment as well as implement corrosion control, cross connection control and backflow prevention (van Zyl, 2014). Road infrastructure is important to ensure entrance to small water treatment plants, as poor road infrastructure dampens the enthusiasm of managers to visit water treatment plants. Hence, this lack of enthusiasm also affects the technical personnel and chemical suppliers who fail to make sure travels are on time (Swartz, Mwiinga, Marler, Meyer, Hlophe, Rajagopaul and Charles, 2009).

2.6 SKILLS AND MAINTENANCE

There was a time where the public sector had 70% of the engineers. Currently, the public sector has only 30% (Kahn 2017). Greve (2011) notes the reduction in number of engineers is reflected in the number municipalities who do not use the entire budget for maintenance and infrastructure expansion. This caused a deterioration of assets such as roads and water infrastructure. This problem is linked to additional service delivery demonstrations. Styan (2008) observe about 300 engineers move out of South Africa yearly.

The root causes for skill shortages are related to wastage, training, migration and workforce exits (Grigg and da Silva, 2008). Yet the lack of skills to operate systems can cause misuse and damage of resources. Water supply infrastructure is, in most of the time, not managed properly and this can be caused by unskilled staff, under funding and an inefficient management (Swartz et al., 2009). There are, however, two main categories of skill shortages. The first category involves technology change, the national economy, globalisation, and regulatory framework, which influence the demand for labour nonetheless. The second category consists of flexibility and mobility factors related to the supply side of the labour market equation and which explain why some workers may or may not be ready to move to another region to fill a position. These second category factors consist of secondary job opportunities for spouses and/or children relocating to the region with the skilled worker. They also include a perceived lack of opportunities in the new region; the work and pay offered; and problems associated with the negative perception that small locations are substandard to metropolitan locations. It can also be influenced by factors such as education, life cycle and training opportunities; social networks; and, infrastructure (Grigg and da Silva, 2008).

Operation and maintenance responsibilities are hardly delegated to persons and may make people to not feel responsible for the use and upkeep of infrastructure. Equipment, skills and funds can be moved away from operation and maintenance by the overlapping of responsibilities. For example, staff can be moved to work on new construction work, while an unsuitable design and technology options may result in needless operation and maintenance problems and increases costs. The design of a project should always consider the long term operation and maintenance. Nonetheless, a poor design is frequently multiplied by an insufficient management of the

construction, while an absence of community participation in project improvement leads to unsuitable designs (Swartz et al., 2009).

Organisations must also promote themselves as a great home to work on. The challenge of recruiting skilled and experienced professionals is a genuine problem facing various regional locations across a range of occupations (Grigg and da Silva, 2008). Municipalities who manage small water treatment plants are not prepared to provide enough attention to small water treatment plants. An important acceptable operation and maintenance preparation should focus on the employment of suitably qualified personnel in important decision-making positions (Swartz et al., 2009). According to Department of Water Affairs, quoted in van Zyl, (2014), money saved on maintenance of assets is not a saving. This is a short-term viewpoint because of political short-term imperatives and lack of capacity within the municipality. It can become a vicious cycle once infrastructure is allowed to deteriorate. However, organisations must ensure that they provide a wide range of services, incorporate technical changes in the way they provide services, engage diverse stakeholders and comply with a range of legislation, as all this add to the complexity of operating and maintaining water distribution systems and let alone attracting appropriate skills.

In addition, most municipalities are struggling with old and deteriorating infrastructure, and a lack of resources, capacity of skilled personnel and that of institutional knowledge. The lack of resources and capacity over and over again forces municipalities to focus on other important problems at the expense of crucial operation and maintenance functions (van Zyl, 2014). One of the main reasons for the production of poor quality water is the fact that untrained persons and labourers are used to operate plants and sometimes the supervisors themselves have little or no training in water treatment. This result in poor control of the operating staff (Swartz et al., 2009) and this adds to the difficulties faced by municipalities with regard to infrastructure management, operation and maintenance.

2.7 THE DISRUPTIONS ON WATER INFRASTRUCTURE

This part discusses the shortcomings of the models used to predict the economic life of water pipes.

The timetable for capital works is based mainly on estimations of pipe disruption rates and age of pipes. This is done mainly by engineering judgment and experience and through the use of past failure and asset information data. Consequently, the disruption rates of separate pipes, or collections of pipes are estimated and these are then used to estimate a likely stream of costs over a future period, for instance ten years. If the projected repair costs over the ten years are more than the estimated replacement costs, then the pipe is replaced (Watson et al., 2001). It should be underscored, however that, rules of thumb tend to dominate replacement decisions rather than healthy statistical analysis. Furthermore, long term yearly budgets may possibly be decided before any annual analysis has been undertaken (Watson et al., 2001).

Aggregated models put together pipes that have the same basic properties and then use linear regression to determine a relationship between the age of the pipe and the frequency of failures. Shamir and Howard proposed an exponential growth with time in this formula:

$$\lambda(t) = \lambda(t_0)e^{A(t-t_0)}$$

Where $\boldsymbol{\lambda(t)}$ the frequency of failures per year at $\boldsymbol{t}$ is the time, $\boldsymbol{t_0}$ is the base year and $\boldsymbol{A}$ is the growth rate coefficient.

A number of researchers have extended the above exponential equation to identify the environmental and intrinsic properties of the pipe with the failure rate. The probabilistic predictive model attempts to forecast the likelihood of a pipe bursting in a certain time. As a result, the model can calculate the economic life of a pipe and when it can be replaced.

The use of the Cox propositional hazard model has also been proposed. The model is as follows:

$$h(t:z) = h_0(t)e^{zb}$$

Where, $h(t:z)$ is failure rate while $h_0(t)$ is an unnamed baseline hazard function. Z is a vector of explanatory variable and $\boldsymbol{b}$ is a vector of regression coefficients.

Both authors, however, used a Weibull hazard model to model the useful life of a pipe.

There are various disadvantages that arise from the models. These include, the limitation arising from the way the models groups related pipes and depend heavily on estimating the lifetime of the groups, which may be very variable and depending on individual pipes. In addition, the aggregate regression models do not offer information on individual pipes nor the variability that may possibly occur between individual pipes (Watson et al., 2001).

2.8 REPAIRABLE VERSUS NON-REPAIRABLE SYSTEMS

Repairable and non-repairable infrastructure and the growth rate of the of pipe failure rate for a new and old pipes are considered here.

A repairable system is one that can be restored, soon after the concurrence of a failure, to an operating condition through repairs rather than replacement. A water supply network is a repairable system and as such, if a pipe fails, it may either be replaced or repaired to make the system back to operation. However, a nonreplicable system is one which is replaced after its first failure. A light bulb for example, is a non-repairable system. Repairable can also include economic considerations. For example, it's better to replace a cheap watch that to repair it when broken, because the cost of repair is greater than the cost of buying another one. Individual water pipe is considered to be a repairable item. However, if repairing costs are greater than the replacement cost, then the pipe will be replaced (Watson et al., 2001).

An estimated growth rate in the pipe failures is from time to time used where it is appropriate. Repair is usually done by a pipe repair contractor who records limited information on the nature

and amount of failure (Watson et al., 2001), is continuously done in response to a pipe failure. This is required as any replacement work is expected to take a long time.

Well-designed water infrastructure is considered repairable as the cost of repair is less that the cost of replacement. The pressure in a newly installed pipe is high and thus water supply disruption is frequent. Afterwards the early failures settle down and the intensity lessens and remains constant for long period of the pipe's useful life. As the pipes age the pressure start to increase and the pipes will begin to deteriorate, which results in more frequent disruptions. The increase in disruption will continue to a certain level where the pipes will have to be replaced (Watson et al., 2001).

2.9 THE COST LINKED TO INFRASTRUCTURE MAINTANANCE

The section focuses on a number of issues related to the costing of infrastructure. It considers the importance of low lost and highlights the estimates for cost and the willingness to pay; implication of low cost and the state of the economy are also highlighted; and outlines the implication of poor maintenance and staff costs.

Cost is a major factor in the provision of municipal services. It is thus important that operation and maintenance is done in such a way that ensures that service is provided at minimum cost over the long term. It is often possible to save major costs in the future by using higher quality components or performing preventative maintenance, even though it will be cheaper not to do this in the short term. In most cases, high cost refurbishments are prioritised and this results less money being allocated for ongoing maintenance. In addition, deteriorating infrastructure leads to poor service delivery and a decrease in payment by consumers (van Zyl, 2014).

Cost is usually estimated to determine the ability and willingness of the community to support the cost of operating and maintaining water system. However, depending on past data for the estimate or using a fixed percentage of system capital costs, may typically lead to poor projections. If the predicted cost is too high, the conclusion will be that the community cannot have enough money for the system; if the estimate is low and the water system is constructed, the

system is expected to fall into disuse or disrepair due to lack of funds for its operation and maintenance (Jordan and Wyatt, 1989). The state of economy may, however, have a negative effect on operation and maintenance as inflation and fluctuating exchange rates can raise the operation and maintenance costs, especially with regard to pump operation and maintenance, which is affected by fuel prices (Swartz et al., 2009).

Water supply systems will unavoidably fail to perform as designed when they are not operated and maintained properly. Inefficient and unsuccessful water systems are caused by lack of adequate funds to support operation and maintenance. Most emerging countries suffer from the insufficiency of funds for recurring costs of operation and maintenance. However, the cost of operating and maintaining a water system must be estimated in advance (Jordan and Wyatt, 1989). The providers' staffing practices must be determined before the staffing cost is determined. The amount of overtime that the system operators may earn also needs to be estimated. Other costs and challenges are significant here. For instance, overtime is normally earned by personnel employed by a government that operates one or more water systems (Jordan and Wyatt, 1989). A lack of accountability in many repairs departments leads to the incompetent use of maintenance funding (Swartz et al., 2009). While an insufficient and inefficient usage of funds for operations and maintenances limits the accessibility of tools, spare parts and the recruitment and training of competent staff.

The determination of replacement costs involves the identification of stuff that needs to be replaced, the year it will be replaced, and the cost of the replacement. The estimator should proceed from the inventory of equipment involved in the system in their estimation of the replacements, in the same way parts are estimated, as described above. An examination of any available records regarding the life of equipment, such as pumps and motors, will provide a good guide. Interviews with operators of other systems are also important. As soon as data has been collected, the equivalent annual cost of these future replacements can be found using discounting formulas. These formulas are built on the economic theory that future values can be translated to present values by using a discount rate. The key formula is:

$$P = F \frac{1}{(1+i)^n}$$

Where: P is the present value of future costs, F is the future cost, i is the discount rate and n is the year of the future cost (Jordan and Wyatt 1989).

Finally, contingency is one of the additional costs that are normally included in operation and maintenance estimates. No estimation can be considered perfectly accurate; so many estimators put an additional amount to cover unforeseen costs, inflation, or other unexpected cost items. It is at all times difficult to estimate costs accurately; hence, contingency ensures that the approximation is not too low. There could be cases, however, when an estimator may wish to leave contingency out. For example, if detailed operation and maintenance cost estimates are being prepared for two engineering designs under comparison, then contingency is unnecessary. The second additional cost is administrative personnel. In some cases administrative personnel are clearly linked to the operation of a system, and sometimes not. For instance, in a village water supply situation, there may be no administrative personnel at the site of a water system whose costs are being estimated, but at a district office there may be supervisors or managers who spend part of their time dealing with the system at hand (Jordan and Wyatt, 1989). If certain overhead numbers are in use by the organisation involved, than they should probably be comprised in the estimate. However, the estimator should be aware of the costs that are included in these overheads in order to avoid any duplication. Low-cost components that will fail more regularly and have to be changed earlier may not really be cheaper if these costs into account. As a result it is vital to maintain a long-term opinion when making decisions on infrastructure investment (van Zyl, 2014).

2.10 SUSTAINABLE WATER SUPPLY

The section will discuss the maintenance, the general management of water infrastructure, planning and causes of failure from infrastructure. It will also touch on how the low prices and poor management negatively affect the service delivery.

The maintenance of and design life of the infrastructure enables the sustainability of water supply systems. Developing countries, however, fail to bring the benefits to society over the long term owing to lack of understanding of the sustainability matters within the water and sanitation sector. Maintenance is thus important throughout the design life of the water supply system (Mwnagi and Daniel, 2012). Addressing sustainable water use necessitates appropriate asset management for water conservation. Reliable water information is also a significant factor in the body of water policies (Tsagarakis 2005).

Large infrastructure development is necessary to ensure water supply. The management of water infrastructure influences the quality and quantity of water supply for agriculture, industries and household consumption (Brennan, 2002). This requires an integrated water resources management approach. The integrated approach implies that resources are managed in ways that maximise social and economic welfare in an unbiased manner and without causing detriment to sustainability of vital ecosystems (Kragt, 2013).

According to the OECD (2009), water resources management and water and sanitation service provision should attract capital, skills and technology. This can only be achieved through the provision of fair compensation. The OECD (2009) notes further that water infrastructure devalues with time and as such money should be spent on replacement, servicing, repairs and updating the systems and structures. The maintenances may be postponed resulting in infrastructure deterioration and failure to provide regularly fresh water and wastewater disposal.

Water companies' operations, which include water and wastewater management, water leakage, metering, and long term planning, are varied and demand efficient planning. Suitable financing and pricing ensure resources conservation, equity, economic efficiency, and affordability (Tsagarakis 2005). Lack of planning is a major reason behind unreliable supply. Such a situation leads to infrastructure failure before the lifetime and re-investment may be required (Schouten and Moriarty, 2013). According to the OECD (2009), inadequate investment and poor governance, is the reason behind the failure of a large portion of the population to have access to water. Dependent on investment and maintenance of water supplies and growth in population, urban populations are likely to be exposed to hydrological shocks (Benson and Clay, 1994). As

a result, government involvement is necessary for the delivery of an optimum level of infrastructure that increases the welfare of society as the effect and incidence of such infrastructure may fall on various parts of society (Fourie, 2006).

Low water price may reduce the improvement in service provision (Kamaludin, Radam and Rahim, 2016). When the setting of price is not clear or complex, consumers are not responsive (Brick, De Martino and Visser, 2017). The pricing water should be followed by a consideration of consumer adoption (Echternacht, 2014). Generally, a low water price and poor water management reduce the capacity of efficient water provision. In addition, while low prices are affordable to most households, it brings in less income and ultimately leads to reduced investment opportunities from the private sector. Ironically, households conserve water and evade water wastage when the prices increase as they will understand the substantial functions of water and not take it for granted. This implies that institutional arrangements and technology should complement each other if resources are to be consumed efficiently and sustainably.

2.11 THE CAPITAL INTENSIVE NATUTURE OF WATER INFRASTRUCTURE

This sub-section deliberates on capital intensive of water investments and how it promotes monopoly profit. It also look at the cost of initial investment.

The price elasticity for low amounts of water is marginal and the service delivery is excessively capital intensive. This shows that one maximises profit by controlling capital assets, which is a trend that promotes monopoly profits rather than the public welfare. However, capital-intensity investments are prone to corruption such as the exchange of bribery and kickbacks on equipment purchases and the awarding of contracts. Such corruption raises the costs of running a business and ultimately that of the entire cost of delivering improvement to the water and sanitation services (Whittington and Hanemann, 2006). Small metropolitan councils can deliver public services efficiently by contracting out capital intensive projects that require specialised skills to service providers that serve many clients and have economies of scale (Dollery, 2003).The fixed costs in water supply create a cost allocation economic problem. Nevertheless, the capital intensity and long life of surface water supply infrastructure, and the prevalence of economies of

scale, make a necessity for collective action in the delivery and funding of water supply that simply does not occur with other commodities (Hanemann, 2005).

Water supply, wastewater treatment and collection are highly capital intensive. The construction of systems and treatment plants necessitates a large one-time investment, while maintaining the operation of water services infrastructure demands continuous repair, renewal and replacement (Hukkaa and Katkob, 2015). The OECD (2009) also notes that the water and sanitation sector is one of the greatest capital-intensive public service systems. The associated cost types need huge financial input that must be raised on lengthy terms for the initial investment and for a tariff that comprises a fixed element adequate to cover the fixed overhead costs of supply.

According to OECD (2009), the quantity and kind of funding needed by the water and sanitation sector is determined by its cost structure. The water and sanitation infrastructures, as noted by the OECD (2007), takes account of upstream facilities, distribution and sewerage networks. As a result, a centralised water distribution requires infrastructure with a high fixed capital cost and a moderately low operating cost. There is no need for subsidising capital on operations and maintenances as both are part of the total cost of providing the service and any subsidisation may perhaps cause distortions such as over-engineered and capital intensive systems. Therefore, nominal tariffs should show the marginal costs, and to ensure affordability (OECD, 2007).

2.12 POLITICAL MANAGEMENT OF SERVICE DELIVERY

Water and sanitation provision to households is critically affected by the political structures that govern a society, this subsection attempts shed light on the issues involved.

Politics affects and is affected by the performance of public services. There are more political benefits that can be realised from responding to visible issues and producing visible goods than those from tackling lower profile tasks or improving systems and processes that are not visible. Visible physical assets are considered a symbol of political strength in service delivery (Batley and Mcloughlin, 2015). There is a link between public voting and service delivery such that the visibility of service significantly determines voting behavior (Mani and Mukand 2007). More

visible public service, such as road infrastructure, than services such sanitation, is preferred more by local politicians. Sanitation benefits many residents but is less visible (Boex and Edwards, 2014). In addition, less visible systems, such as the maintenance of water services infrastructure and the improvement of waste water removal, are most likely to be neglected. There are incentives toward producing over-ground expansions like school construction than with the less visible water pipes. In fact, waste collection and road maintenance are visible while sewerage disposal is not visible (Batley and Mcloughlin, 2015). The World Bank (2011) underscores visibility but adds that sometimes rent-seeking opportunities become more important incentive to those in power.

There is a strong technical favouritism, among engineers, for traditional sanitation investments such as sewerage-based service provision, often at the expense of appropriate technological choices. The sector is characterised by political and technological preferences that benefit the minority and affluent urban residents at an expense of the poor majority. Batley and Mcloughlin (2015) note voters prefer targetable private transfers such as jobs, cash and subsidies than focus on public goods. In addition, citizens are aware of the short-term visibility of the benefits and results owing to the politicians' action. The failure to easily observe and measure the outcomes for services usually means that providers cannot take credit of the benefits to users. Healthcare and community sanitation are only understood and visible in the long-term and usually become visible through a health crisis.

The incentive for politicians to provide a service is better where there is more excludability. These services benefit the private instead of the public and thus exacerbate inequality. The incentive for politicians to deliver service is greatest where there are targetable private gains instead of public benefits. Political inducements to deliver services rise in situations where services offer high excludability, low information asymmetry, high visibility and high atributability. Political incentives increase with the possibility of excluding some users and the service favours particular individuals or groups. The incentives also increase where user benefits can be clearly attributed to political intervention, and lead to an increased visibility and public profile. Local government politicians are closer to voters and thus may be motivated to respond to their preference. Low excludability has the reverse effect of weakening political commitment

to provision. In particular, non-excludable and therefore non-targetable public goods are often neglected because they offer limited scope for servicing favored constituencies (Batley and Mcloughlin, 2015).

Collective action to solve problems is easy to organise in a situation where there is a visible boundary of consumption. This assists users to achieve collective heterogeneous preferences and interests. A single point of contact amongst users and providers is linked to collective action. Sanitation programs organised through collective action by communities may be more effective than other government subsidies schemes. However, they provide little political attribution and do not attract much political support. The capacity to organise collectively is greater when service is within a limited territory and likely to provide visible short-term benefits. This allows consumers to determine the quality of services, have opinions and demand (Batley and Mcloughlin, 2015). The sanitation sector has less potential for collective action, limited visibility and political appeal. Urban dwellers and politicians underestimate the importance of sanitation (Boex and Edwards, 2014). There, nevertheless, are collective action challenges, political market imperfections, lack of effective performance oversight, policy incoherence, or contradictions, and moral hazard (Wild, Chambers, King and Dan 2012).

Openly praising politicians for accomplishments in services delivery act as incentives for the politicians to prioritise the services they would have been praised for (Batley and Mcloughlin, 2015). Generally, investment in sanitation increases as elections approach. This is, however, an increase in public services spending to influence the outcome of that election, which limits the impact of governance performance on voter preferences (Boex and Edwards, 2014). Hence, there is a need to measure governance against service provision.

Policy makers can easily monitor and control service provision and infrastructure such as buildings with the aid of proper procedures and outputs delivery targets. Control can be easily facilitated by identifying specified services in advance, and establishing low provider autonomy and high territoriality. In some services, policy-makers could undergo information asymmetry about the performance of providers just as consumers do. Some outputs cannot be easily

monitored as they depend on both the capacity of government and nature of the job being done (Batley and Mcloughlin, 2015).

2.13 INFORMATION ASYMMETRY

This section explains how information asymmetry disadvantages the consumers from demanding services. It discusses the negative impact information asymetry on the voice of the citizens.

Information asymmetry is defined by Batley and Mcloughlin (2015) as a situation where users are less capable of evaluating the quality of services leading to challenges for citizens with regard to assigning praise or else blame for performance. Information asymmetry weakens political inducements to increase provision. It is also a less efficient distribution of resources and an increase in potential conflicts. Public managers contend with political interference and as a result, they constantly need political support from authorities, client groups and constituencies (Araral, 2008). User power to demand service improvements falls when services users receive limited information. However, information is not an answer to user accountability as it is an essential condition (Batley and Mcloughlin, 2015). As a result, information asymmetries amongst council bureaucrats and citizens regarding the nature and costs of municipal service delivery can restrain the effectiveness of voice. Hence, situations where services are extremely differentiated may yield particular citizens' expression of concerns influencing the performance of a specific service rather than the whole service system, while the voice will have broad effects in undifferentiated services (Dollery, 2003).

Politicians face challenges owing to the reality that citizens do not trust that politicians can deliver their promises on issues such as service delivery. For instance, the quantity of water supply is easier to evaluate and yet an assessment of the quality of water supply is not an easy task, as a result, this may reduce the politicians' drive to ensure the delivery of quality service (Batley and Mcloughlin, 2015). Households' perceived economic benefits of increased water and sanitation investments are not a true reflection of the real benefits that people receive after improved services (Whittington and Hanemann, 2006). Contamination in the water supply cannot be easily recognised by consumers. It is also expensive for utilities to find leakages in

underground pipes, and even to locate the pipes (AraraL, 2008). Nevertheless, the delivery of particular services and goods may be neglected in situations where politicians struggle to claim glory for their delivery or that in which users find it difficult to understand their benefits (Batley and Mcloughlin, 2015).

Therefore, water supply can reach the goals after meeting the three conditions: credible commitment to abide by contracts and enforcement, great incentives to encourage managers to comply with contract, and the reduction of information asymmetry between the regulator and manager (Araral, 2008).

2.14 BUREAUCRATIC DISCRETION AND ITS IMPACT ON THE POWER OF POLITICIANS

This subsection focuses on the balance of power between policy makers, providers, and field staff. In addition the subsection highlights the monitoring and control by policy makers.

High bureaucratic discretion moves the balance of power away from politicians, policy-makers, managers and possibly users, towards providers, contractors and field staff. Measurement and control is difficult in situations where decisions are exercised by front-line staff. However, the establishment of clearer territorial boundaries about the intake of a service increases the capability of the state to monitor performance and hold providers to account. Yet the problems of organisational control may multiply in the event of front-line bureaucrats exercising high discretion or owing to the existence of difficulties in measuring processes and outputs. As a result, organisational control cannot multiply in cases where service providers wiled organisational autonomy through expert knowledge, and where consumption is physically dispersed or fragmented.

It should also be underscored that situations where processes and outputs are effortlessly specified and measured necessitate easy, it then becomes easier to control and monitor. In addition, monitoring and control are effective in case of a public good and where managerial information is accessible. Provider knowledge offers provider with an advantage of effective

capacity to form and control their own interest. It is difficult for politicians to demand service improvements when they rely on front-line providers to get votes. High technical content and scarce knowledge are related with provider autonomy. This means that agents may have more power over principals through the strength of their expertise with such situations likely to be worse in cases where the service is monopolistic in nature. Policy-makers and managers are more able to monitor and control providers in situations where providers have a low degree of professional dominance and exercise relatively little discretion. The problems in controlling, reporting and monitoring provider performance impact on the politicians' and users' capability to assert influence above front-line staff and delivery organisations. Finally, in line with the study, networked water can be easily regulated than the informal market of non-networked providers (Batley and Mcloughlin, 2015).

Engineers prefer old-style sanitation investments like sewerage-based service provision frequently at the expense of fitting technological options. Engineers and bureaucrats lack influence over technological debates. This restricts the adoption of large scale on-site sanitation and house systems. Such situations weaken the efforts seeking to increase sanitation supply to the poor (World Bank, 2011). Political and technological preferences favor the affluent urban residents rather than the poor (World Bank, 2011). Quality water services gives confidence to consumers while poor quality services endanger people's lives of and damage the reputation of a provider (Kamaludin, Radam and Rahim, 2016).

2.15 THE PUBLIC PRIVATE PARTNERSHIP (PPP)

This subsection deals with the public private partnership in provision of water services. It touches on the feature that makes the cooperation between public and private problematic and the benefits of PPP.

PPP seeks cooperation among the public and private sectors in delivering public goods. Private enterprises offer their cooperation in public administration with an aim of improving the quality and efficiency of public service delivery (Obosi, 2017). The Principal-Agency Theory sets the origin of the relationship where one party delegates a job to another, who does the task. The

principal is reliant upon an agent whose interest differs from his own but, still wields power as he/she is in charge of remuneration (Kamara, Ofori-Owusu and Sesay, 2012). This contracting of the provision of public services to private sector agents is an alternative to creating enclaves. As a result, the best way to ensure service provider accountability is to have payment dependent on the actual, successful provision of the service (Hogg and Samson, 2011).

There are challenges that make the cooperation between the public and the private sector difficult. The first one relates to the high fixed costs arising from long-term irreversible investments and inelastic demand. The second challenge is that water is a basic need and quality of access has an impact on externalities on issues such as health, gender equality and the environment. This creates a need for political interest or government intervention. The third challenge arises from the fact that water and sanitation requires local management but externalities need an integrated water resource management that reflects the whole water cycle. The fourth challenge is that the sector is challenging to organise, due to both separation and number of stakeholders. The fifth challenge relates to the way in which the sector gain strength relating to foreign-exchange risk, contractual risk, and political interferences and sub-sovereign risk. The final challenge is pricing as the sector has numerous objectives (OECD, 2007).

The principal can, nevertheless, align the interest of the agents to his own. This can be achieved by establishing: i) a performance monitoring and evaluation system, ii) structure for assigning decision rights to consumers, and iii) a compensation and penalty system. The main point of the principal agency theory is the relationship between the principal agent and its impact on the demand-side. The problem of agency is prominent on the demand-side of public service delivery and is caused by the fact that politicians, clients and frontline providers have different interests (Kamara et al., 2012). Thus, any exploitation of positions for personal benefits destabilises the efficiency of government programmes (Rose-Ackerman, 2004). This emphasises that risk allocation is an important factor in working with the private sector in water and sanitation. Water and sanitation projects are capital intensive and involve high initial investment, long payback periods and a low rate of return. In addition, infrastructure is fixed, and cannot be used for other purposes.

Good infrastructure in general produces a positive externality. A rise in private-public partnerships demands a high government participation in the verification processes in order to decrease the bargaining costs of participants through regulation with the intention of reaching the ideal level of infrastructure goods (Fourie, 2006). According to SIWI (2004), public and private investments are required for an improved water management for the economy to cope during rainfall variability. An upgraded water resources management is important for stability and security that supports economic development. Zandamela (2002) notes government will support the involvement of the private sector in the construction of improved water sources. However, government will keep a certain implementation capacity to intervene in the areas where private participation is not a good option (Zandamela, 2002). The net benefits from connecting the private sector in infrastructure development and management include relieving budgetary burden, network expansion, and improved efficiency in service delivery, long-term sustainability, a reduction in costs, and technology transfer (OECD, 2007).

The results of PPPs arrangement are mixed. There are, however, more cases of success than failure. The government has a responsibility to deliver water to the community with communication occurring in various forms and scope between the government, the private sector and the public. Hence, the quality of provision of water service is affected by the nature of the collaboration between the government, the private sector, service providers, and consumers (Obosi, 2017).

2.16 ACCOUNTABILITY IN SERVICE DELIVERY AND THE VOICE OF THE CITIZENS

This subsection will look the voice of impacts on accountability, impact or power of the median voter inn influencing service delivery. It will look into the short and long route towards accountability and the link between efficiency and accountability.

Consumers and the public express their sentiments regarding their likings for a different mix or quality of services through different administrative mechanisms such as electoral voting or complaints and surveys to public service managers, and not by moving away from their

municipal jurisdictions (Dollery, 2003). Voice and accountability measure the degree to which the citizens are capable to partake in choosing their government and their levels of engagement with freedom of association, expression and the free media (Araral, 2008). Lack of a political voice may prevent the rural or urban poor from being heard by those in control of distributing resources for water supply and sanitation improvement. The bulk of the urban poor are dependent on private provision for their water and sanitation necessities (Bosch, Hommann, Rubio, Sadoff, and Travers, 2002). The power of users is more than that of providers in situations where services offer low rivalry, low monopoly, low information asymmetry, high frequency or predictability and high territoriality (Batley and Mcloughlin, 2015). Details can also be critical: if a conversation is held only in English and in settings chosen only by officials as ordinary citizens are likely to feel excluded in such circumstances. In addition, the existence of a communication gap between politicians and citizens is that many people might choose to remain silent even when they wish to speak, especially in societies where undemocratic hierarchies have long been entrenched (World Bank, 2011).

The socioeconomic situation of the people in a particular area influences their likelihood to express the voice. The affluent and educated express their voice more than those who are poor (Dollery, 2003). Furthermore, the majority of consumers are poor, outside of the cash economy and hence, politically weak. As a result, it becomes easy for local governance and service providers to direct service delivery to the rich only while the poor remain neglected (Bosch, Hommann, Rubio, Sadoff, and Travers 2002).

Different services have different impact on politics and accountability. Health care differs from water supply (Batley and Mcloughlin, 2015). Nevertheless, the ability of users to organise may be disadvantaged when the size of the space in which a service is consumed is large. Services that are dependent on community maintenance, through the creation of consumer groups, may suffer if the sheer size of the territory over which these groups preside exceeds their physical capacity to get out and monitor it. Politicians are expected to listen to the demands of current users yet citizens who do not have access to piped water lack a basis for organising and are simply neglected (Batley and Mcloughlin, 2015). The median voter model is important to how electoral politics influence public choice. In an ideal representative democracy that based on

single-member constituencies, politicians would normally adopt policies that indicate the views of the median voter which reflect the demands of the majority of voters. A median voter is the voter closest to the middle of a given political spectrum, when ranked with all other voters. By encouraging for the preferences and positions held by the median voter, politicians can have an upper hand over competitors whose positions are less widely supported (Boex and Edwards, 2014). Collective organisation is negatively affected by private benefits such as access to household water connections that can be targeted on preferred people by the provider (Batley and Mcloughlin, 2015). Hence, cultural and social norms form preferences and may tilt the balance of individual choice in favor of collective action (Hanemann, 2005).

There exist three accountability relationships among citizens, politicians or policymakers, and service providers. Citizen voice involves civilian attempts at influencing the political and contract relationship between politicians or policymakers and service providers as well as client power where citizens, acts as clients. The accountability between citizens, politicians and service providers has both a short and long route. There is first leg of the long route pertains to the political way which involves citizens' attempts to influence politicians through voting and engaging in communication with politicians beyond the electoral process. Politicians and policymakers here constitute the central state and are responsible for setting policies and allocating budgets (Hogg and Samson, 2011). Hence, citizens must try and hold government officials accountable when it is clear who is liable for a particular service. In addition, local political dynamics are vital in local service delivery funding decisions just as local fiscal dynamics are important in determining how public funds are allocated, especially, the way in which local sanitation infrastructure and services are financed, which Boex and Edwards (2014) note has an impact on the level of local sanitation expenditures.

This second leg of the long route to accountability involves the relationship between politicians or policymakers and the frontline service providers. This leg is about the vertical accountability relationships in the state to deliver public services. In this case politicians, who would be receiving citizens' expression of their priorities and preferences on particular policies, are viewed as policymakers receiving policy feedback. Policymakers usually reach agreements with public, private, or nongovernmental service providers on the delivery of the services demanded

by citizens. This long route, nevertheless, represents the way in which accountability manifests in the modern state, wherein citizens elect and influence their political representatives, who in turn form and lead a government to deliver a variety of public services. Any failure by politicians leads the citizens to vote the politicians out of power, which implies that in theory politicians, have a strong incentive to hold public servants accountable for services. This feedback mechanism, therefore, suggests that services are bound to continually improve.

The short route focuses on the direct interaction between citizens and service providers. The delivery of services should be met with the citizens' use of client power in order to influence the service providers. The existence of this agreement solely between agents in the public service and citizens is called a compact, while the agreement arising from a government hiring of a private or nongovernmental provider to deliver the services is called a contract. A compact, considered by Hogg and Samson (2011) as the third leg to accountability as short route, relates to state capacity, command and the control part of service delivery within the government bureaucracy. Ultimately, accountability is robust when both the short and long route to accountability work, just as the accountability relationships are important to improving service delivery for the poor. In addition, accountability is greater when the short and long route work well and as Hogg and Samson (2011) state, an improved accountability means the poor will get better services. A country like South Africa seems to take the long route to accountability.

A number of services are involved here and these are: delegation where citizens choose a local politician to manage their municipality, finance which involves the payment of taxes to allow politicians to make budget decisions, and performance which relates to service providers producing services. These services are assessed by citizens based on their experience and information, and citizens ultimately act politically or legally to control the local politician through what is termed enforceability. In addition, service characteristics have economic or managerial implications, and influence the politics of service delivery. The type of service has a powerful influence on the inducements for politicians to commit to services, relations of control and monitoring between political actors and provider organisations, and on the level of citizen burden for services and the way this is voiced (Hogg and Samson 2011). Hence, an improvement

of accountability in service delivery and availability of sanitation services is important in the management of sanitation investments (World Bank, 2011).

A failure of citizen engagement leads to a weak accountability. This suggests that the provision of information is an important part of the solution and as such the way in which the government informs its citizens is also as important. Citizens should, however, choose services, determine how they are provided, and link with grassroots organisations in order to initiate government-citizen interaction that will increase accountability (Hogg and Samson 2011). Finally, an effective service delivery can be achieved if the principals hold agents accountable. In addition, consumers should also hold Providers accountable and the Providers themselves must be willing to account to consumers (Kamara et al., 2012).

Effective service delivery is linked to the degree of accountability while effectiveness in the basic services delivery is related with quality outcomes (Kamara, Ofori-Owusu and Sesay 2012). The importance of water suggests the need for (1) voters to hold politicians accountable and ensure that water supply is affordable, (2) rules for protection against monopoly power, (3) a regulatory framework that implements rules, and (4) subsidising water supply for the poor (Araral, 2008).

2.17 LEADERSHIP

This subsection focus on the requirement of leadership skills in organizations to address the changing demands.

No single leader can solve all problems, as a result, all senior members or skilled employees in key positions of an organisation have to, any extent possible, be leaders. There is also need to develop new skills of leadership and to address the salient problems of conflict of interest. Functional and technical skills are not sufficient. Instead, leadership skills are required to improve service provision in South African municipalities. These skills are indeed required to address the ever-changing demands for improved services and the need to address the past inequalities that are normally placed on local authorities (Pretorius and Schurink, 2007).

2.18 WATER SUPPLY TO THE POOR

This subsection focuses on the negative effects of water shortages or lack water and sanitation. It touches on how the demand for sanitation can be improved. The subsection also looks at the impact of income and education on water services and challenges of water provision for informal households.

A lack of water and sanitation services to the poor lowers their income earning potential, raises their living costs, damages their happiness, and makes their lives risky. A universal deterioration of the surface and underground water sources means that water and sanitation pressures will be worse in the future (Bosch et al., 2002). Broader participation and flawless communication are the two significant tools that address the needs of the poor with regard to sanitation investment and services provision (World Bank, 2011). An understanding of the risks and opportunities linked with institutions and stakeholder interests in the sanitation sector could be used to support pro-poor sanitation investments (World Bank, 2011). In addition, the demand for sanitation can be improved through an awareness and hygiene education (Bosch et al., 2002).

Higher income increases the ability of households to buy and use water-intensive appliances and facilities. The reality is that higher income households are more likely to have additional bathrooms, larger yards, outdoor landscaping, swimming pools, and lawn irrigation systems. In addition, higher income households are less concerned about the cost of water. Another socioeconomic influence on public-supply residential water use is the diminishing size of households and the growth in their number. Water required per unit for single-family dwellings is much greater than for multifamily dwellings, thus an increase in single family dwelling construction effects long-term water use (Marella, 1992). Conditions, such as the education of the breadwinner, age, number of family members, and spending per capita, affect the accessibility of facilities for sanitation, garbage handling and drinking water. Education is very critical in the potential of ownership of drinking water and sanitation facilities (Harapap and Hartono, 2007). Furthermore, Whittington and Hahnemann (2006), state that the transportation

of water can be very costly. Hence, there is a close correlation between services for water and sanitation and households income.

Improving water and sanitation services for the poor depends on a number of factors. These factors include: (a) an efficient delivery of public and private services, (b) sustainable management of water resources, (c) better access to those services, (d) functioning pro-poor financial mechanisms and (e) and research on, development, and implementation of low-cost technologies (Bosch et al., 2002). The monopoly on service delivery has caused lack of accountability and community ownership, poor management and sustainability, low-quality services, and weak development of the private sector and delivery options (Bosch et al., 2002). International institutions, however, use a comparative advantage in providing well-timed and difficult analysis in their provision of advice on pro-poor sanitation investments. Donors and lenders can ease the exchange of experience among countries and support local policy makers with studies that find resonance with national (World Bank, 2011). Nonetheless, there can exist an unstable policy environment due to limited political commitment, poor governance of and weak legal framework, which, as noted by Bosch et al., (2002) leads to underinvestment, poor participation, and conflicting priorities.

A lack of household water has huge costs. Household members are forced to bring water from other sources, including unprotected rivers, canals and lakes. Rural households will be required travel a long distance to fetch water. The average time it takes to fetch water in rural areas in Sub-Saharan Africa is 36 minutes and 23 minutes in Asia (Meeks, 2012). The time spent reflects the opportunity cost of lack of water and sanitation investment. Whatever is actually done with the time, whether consumed in leisure, household production, or income-earning activities, the true opportunity cost is the sum in monetary units that the person would earn over the period of time if he was working (Hutton and Haller 2004).

There are potential benefits that arise from improving water and sanitation. Wagner and Manus (2008) state that there are substantial economic benefits which can be derived from improving the water and sanitation services standards in developing countries. Putting water into informal settlements has fewer benefits than putting new sidewalks and parks in the rich neighborhoods,

but these poor citizens will keep those politicians who manage resources well and respond to their needs in office. Hence, it is easy for politicians to command the loyalty of a population in need of services than one that has full services (Solo et al., 1993).

The poor, the majority of who are found in rural areas and informal spaces in big and small towns, are marginalised when it comes to receiving better water and sanitation services. Informal urban settlers do not have technical knowledge and assistance; as a result, they develop their areas haphazardly and without adequate space for installing infrastructure lines (Solo et al., 1993). This lack of access to water and sanitation limits the opportunities to escape poverty (DWA, 2013). Ironically, those who gain from public services pay marginal costs to their new service. The poor who live in informal settlements end up paying more than the higher-income families who live in the formal sector, since the costs of extending a water piping is currently higher than what the cost of installing a system of pipes was 20 years ago (Solo et al., 1993). Low income families do not have money to invest in infrastructure and lack the support of banks who could lend them money to invest in infrastructure (Solo, Perez and Joyce, 1993). Hence, the highest blockage to getting services to the poor is hostility at local, national, and international levels and the way in which local engineers and expatriate advisors favor systems which are used internationally even though most of these systems may be inappropriate for the local conditions (Solo et al., 1993).

2.19 FEMALE-HEADED HOUSEHOLDS

This discuss the lack among female headed households which results in lack of water and sanitation among the these households.

An insufficient provision of piped water and sanitation affects the poor (Dungumaro, 2009). Generally, female-headed households have inadequate access to resources. Female-headed households are in most cases poor, underprivileged and challenged by economic scarcity. As a result, improving sanitation contributes towards gender equity and other factors such as the establishment of environmental safety, strengthening of education and leads to economic growth (Van Minh and Hung, 2011).

There is a broad agreement that household income is a powerful predictor of domestic water quality. This links directly with poverty where female-headed households tend to be the poorest and thereby exposed to reduced water quality and/or poor sanitation. It is important to note that water poverty does not necessarily arise due to poor access but rather that those with a poor income base cannot afford to get connected (Rhodes and McKenzie, 2015).

2.20 EDUCATION FOR HOUSEHOLDS

This subsection talks of the influence of education and mass media on the willingness to pay for water services.

The willingness to pay depends on the level of education, income, perceptions on water quality and exposure to media. An increase in the level of education leads to an increase in the willingness to pay (Khan, Iqbal, Saeed and Khan, 2010). Findings show that the level of education of a decision-maker and exposure to mass media, improves the willingness to pay for the water purification. Many households in developing countries shift significant resources into treating water for drinking consumption (Khan et al., 2010). Their willingness to pay is influenced more by the level of education than income level. Exposure to education and mass media have a statistically importantly influence on taking on different purification devices and the willingness to pay (Khan et al., 2010). In addition, households' decision to adopt an improved water purification method is interpreted as part of households' risk averting behaviour.

The education programmes offered to users can be in different forms such as the Public Education Programme, bill inserts television, newspaper and radio campaigns, school programmes and public displays. The Public Education Programme may improve household willingness to implement drought management strategies in several ways. The programme means include (1) the provision of information to consumers for better water use, (2) increasing consumer awareness on environmental consequences of diverting water during drought, and (3) making water saving a norm because everyone is restricted on water use. As a result, education programmes have a huge impact on the way households manage and pay for water resources.

2.21 SANITATION SUPPLY

The subsection focuses on the under provision of sanitation services relative to other services. It also looks at the influence of the socioeconomic status of the households.

Relative to piped water access, having access to a flush toilet is dependent upon a number of socio-economic variables. These variables include household size, the number of people employed in the household, connection to the electricity mains, geographical location, gender of the household head, educational level of the household head and the dwelling type (Rhodes and McKenzie, 2015). In addition, people prefer paying less and having access to communal taps and hand pumps than in-house water and sewer connection, which results in lower benefits and costs from the simpler technologies (Whittington and Hanemann, 2006).

Certain services are consistently under or over-provided relative to others. Water supply is over provided relative sanitation, and infrastructural is over provided than social services (Batley and Mcloughlin, 2015). A plausible explanation could be that piped water relative to flush sanitation has been largely addressed as a supply-side issue, with government expanding infrastructure to accommodate households country-wide. However, the same practice does not seem to have been applied to flush sanitation services thus indicating that poorer households are significantly worse off. This could be indicative of a lack of infrastructure and service delivery in poor rural areas (Rhodes and McKenzie, 2015). Governments are dedicating less consideration and resources to sanitation services than they are with regard to water supply and other infrastructure services. In addition, sanitation investments and service delivery are not frequently pro-poor as the investment tends to benefit the rich at expenses of the poor and rural households. Investment in sanitation is largely determined politically rather than technical and yet sanitation is needed for an increase in investments and to reach the rural and urban poor. Hence, assessing stakeholder interests, identifying incentives, identifying potential winners and losers, and examining formal and informal institutions provide a better understanding of the risks and prospects linked with institutions and stakeholder interests in the sanitation sector (World Bank, 2011).

2.22 PUBLIC, MERIT AND PRIVATE GOODS

This subsection discusses the merit, public and private goods. it touches on the interest of the public and the benefits for merit goods. It also looks at the benefits for public goods and difference between public goods and externalities. It also discuss the conditions when water is treated an economic good.

Merit goods are those goods that should be encouraged to consume and these goods can be provided in the private sector but they offer external benefits and are usually provided by the national fiscus. Water is a merit good: as the cost of providing the water are less that the health benefits, gains through water provision (Perry et al., 1997). Merit also shows that individuals are not always able to act in their own best interest (Fourie, 2006). Nonetheless, the provision of merit goods such as piped water to a community upstream benefits that community and the one downstream as downstream will also consume less polluted water. In addition, the spread of water-related diseases in the region is prevented.

Preventive healthcare and community sanitation have strong public goods features but produce individual benefits that are not easily understood or visible. Public goods attract collection action problem because of private benefit are appreciated. In the sanitation sector, households can be motivated to obtain flush toilet for dignity, prestige. However services such as defecation free environment benefits everyone around the area (Batley and Mcloughlin, 2015).

The only difference between public goods and externalities is that, with public good, all the members of the society uses the same good, but with externality, the secondary party consumes different goods from the consumption of the direct purchaser of the goods (Fourie, 2006). An externality is positive if the operations of a producer or consumer provide benefits to another agent where the marginal private benefit is lower than the marginal social benefit. An externality is also negative when it imposes a cost on the other agent where a marginal private benefit is higher than the marginal social benefit. Externalities can be a prevalent difficultly at the level of local government. Sewage treatment, municipal abattoirs, zoned industrial areas, and many other local authority facilities situated near demarcated boundaries can execute major negative

externalities on people in neighbouring areas (Dollery and Wallis, 2001). According to the OECD (2009), people are not willing to pay for something that cannot be excluded; the competitive market will not deliver adequate public goods. While externalities can originate from private and public goods, public goods always produce positive externalities for all users that cannot be excluded from their benefits as noted in the way downstream dwellers benefit from upstream wastewater treatment.

Competition will not cause governments to deliver goods and services efficiently. It however, ensures that specific communities with particular tastes in local public goods are accommodated. Therefore, local governments have an inducement to meet the public good preferences of their constituents (Dollery and Wallis, 2001). For instance, the abatement of lake pollution is public good, as clean lake water is there for everyone to enjoy. Water is both a private good and a public good as it is used at home, in a factory or in agriculture as a private good. The water in a reservoir is a private good but the storage capacity of the reservoir could be a public good. By contrast, goods like food, clothing or shelter are purely private goods and have no public goods aspect. This is the reason why, water is, unlike other commodities, not viewed in economic terms only. Furthermore, groundwater or water flowing through the distribution system of an irrigation district may be non-excludable as both are public pool resources.

It should be underscored that the provision of goods through collective action may be limited because of a failure of inducements. Olson notes that individuals with common interests may certainly be counted on to act voluntarily to further those common interests (Hanemann, 2005). However, according to OECD (2009), the use of merit goods is likely to be below the social optimum for two possible reasons: (I) positive consumption externalities are ignored by private consumers; or (II) individuals are myopic and maximise short-term utility and ignore the private long-term benefits. Thus, the willingness to pay for basic sanitation services and wastewater collection tends to be lower than their societal value.

Many environmental goods are public goods. The OECD (2009) notes that public good examples include activities such as flood management, hydrological monitoring, ecosystem protection, and storm water drainage (Perry et al., 1997). The atmosphere and biosphere are global public goods

(Niftier, 2012). Carbon emissions and rain forest and species destruction are internal public bads within a country but also harm other countries (Nafzier, 2012). Water is a social good whose availability at a lower market price will serve the greater benefit of society as a whole. Similarly, tobacco and alcohol, which are unsocial goods, are priced in excess of the prices that would have been in a free market (Perry et al., 1997).

Water is both a public and a private good. If this is view is correct, then the true economic value of water is different from its financial value (Perry, Rock and Seckler, 1997). According Fragoso and Marques (2013), water must be treated as an economic good as well. Van Der Zaag and Savenije (2006), in concurrence, assert that water is an economic good because it is scarce and cannot completely satisfy demand for all its alternative uses. The quantity of rainfall that falls on the continents is limited. In many situations water must be considered a public good. In such situations markets will fail and it should be the responsibility of governments to ensure safe access to water and that society is protected from water-related hazards (Van Der Zaag and Savenije, 2006). Treating water as an economic good ensures that those who pollute pay and those who consume water pay. This implies pollution prevention and environmental protection (Zoumides and Zachariadis, 2009). The only choice to be made is how to distribute water and finding the most efficient way of consuming it. Hence, water is special economic good (Van Der Zaag and Savenije, 2006).

Local public goods confer benefits to a limited geographical area such as parks (Black et al., 2008). Residents gain directly from local wastewater collection and private good. The treatment of wastewater is basically a public good with public benefits (Boex and Edwards, 2014). According to the OECD (2009), wastewater treatment is a public goods or at least a quasi-public good. While users can be excluded from wastewater treatment connection, this does not exclude polluters in an area with a wastewater treatment from the benefits. Therefore, this service has public good characteristics. According to lo Storto (2013), an improvement in service delivery, increased investment in technological innovation, decrease in operative costs, and the availability of financial markets will effortlessly work in consistence with the necessity to preserve the nature of water as a public good. The economic basis for public delivery is linked with problems of public goods, natural monopolies, positive externalities, and equity in distribution. Problems

associated with public provision are caused by: (1) below-cost pricing, (2) non-credible enforcement of performance contracts (3) non-credible threat of bankruptcy, weak competition, agency challenges, inflexibilities and performance measurement challenges (Araral, 2008).

2.23 MARKET FAILURE

The section focus on market failure and the government intervention to reduce information asymmetry and reduce monopoly influences.

Public services have market failure features, which means an unregulated market will either provide at a lower than necessary value or not deliver altogether. The state may possibly intervene by taking over public service provision or control it in order to lessen information asymmetry, recover from the negative influences of monopoly tendencies, or to produce positive externalities and avoid negative ones (Batley and Mcloughlin, 2015). Contracting is usually not successful when consumer choice is reduced and if there is an absence of a strong regulator working in the interest of citizens. State capacity may be insufficient to manage the complexities of long-term contracts or those particularly difficult to design and monitor (World Bank, 2011).

Some services are linked more to market failure than others. There exists information asymmetry in services such as education and health-care than on waste collection. The availability of an information asymmetry means that citizens cannot simply make selections based on an evaluation of the quality and efficiency of the services provided (Batley and Mcloughlin, 2015). Output and performance is difficult to measure or value. As a result, it is hard to determine the right size of public bureaucracies and leads to changing degrees of inefficiencies. In addition, lack of competition among public agencies undermines the urge to innovate in this sector unlike in the private sector (Araral, 2008). The relatively high degree of voter apathy in local government, in comparison with its national and provincial counterparts, is responsible for the greater scope for local government failure. The common existence of monitoring and accountability problems suggests that citizens may experience complications in determining the performance of municipalities and who would be in charge (Dollery, 2003).

Finally, market failure happens where individuals do not realize or appreciate their own interest (Batley and Mcloughlin, 2015).

Publicly agencies owned as either public bureaus or as state-owned enterprises are fundamentally faced with varying degrees and types of inefficiencies such as information asymmetries, limited competition, incomplete contracts, and inflexibilities (Araral, 2008). Urban piped water supply has a natural monopoly arising from high investment costs and economies of scale, which creates a difficulty for alternative suppliers to participate (Batley and Mcloughlin, 2015). In fact, literature confirms that public sector monopolies are connected with inefficiencies and an inability to meet rapidly increasing demand (World Bank, 1994).

2.24 EFFICIENCY IN THE DELIVERY OF SERVICES

This subsection discusses efficiency. It highlights the technical and economic efficiency. It also touches on the benefits for services delivery in small Water Services Authorities and those that are experienced in large Water Services Authorities.

Efficiency in the public sector is determined on whether the public sector produces public services according to demand and preferences of the citizens (Black, Calitz and Steenekamp, 2008). Generally, water shortages are not always due to poor efficiency. Nonetheless, Van Der Zaag and Savenije (2006) note that operational errors, such as waste discharge, lead to the occurrence of damage somewhere downstream. The fact that some water not consumed in farms ends in the hydrological systems is also indicative of technical efficiency, which differs from economic or water use efficiency. Economic efficiency is based on the amount of water that is consumed (Brennan, 2002). Finally, the entrance of private actors into the market results in the most effective improvement of management and efficiency owing to the amount of financial resources that will be made available by the private investors (lo Storto, 2013). Galiani , Gertler and Schargrodsky, (2003) observe that privatisation is associated with services quality, productivity and profitability.

Allocative efficiency is also important towards the achievement of an efficient delivery of services. Generally, downstream users are subject to the return flows of upstream users and as such improving the efficiency of those upstream uses will reduce return flows and effects downstream. The abstraction of groundwater from an aquifer will result in less water flowing into the river at some point (Van Der Zaag and Savenije, 2006). As a result, there is need to improve the allocative efficiency by establishing a decentralised system. This depends on political and institutional mechanism where a sub-national department can be made aware of the electorates' preferences and be held accountable for their actions. However sub-national governments may lack capacity and be vulnerable to corruption (Black et al., 2008).

There are features of local government service delivery that make it difficult for productive efficiency. These features include (b) problems in estimating the costs of service delivery (b) multiple inputs and outputs in service delivery (c) the existence of different stakeholders with competing needs, and (c) non-discretionary factors outside the control of local government (van der Westhuizen and Dollery, 2009). Allan's model of virtual government is established from the proposition that a gratification of the community with services is a drawn from whether they see requirements of residents and the cost. Municipal performance is evaluated on the on the basis of effectiveness, efficiency and appropriateness. Allan maintains that the fulfillment of community service desires is subject to two basic attributes of service composition: the appropriateness of services and the effectiveness of service delivery (Dollery, 2003).

Persons from smaller municipalities have the advantage of access to their elected representatives. This allows them to make their feelings well-known regarding the suitable mix of taxes, value for money and services. Large councils were made for economic of scale yet most of the services they provide exhibit diseconomies of scale thus leading to their failure. There is less scope for cross subsidisation in small municipalities, the connection between service quality and service cost is more obvious to constituents than to their counterparts in large municipal jurisdictions (Dollery, 2003). Furthermore, authorities in smaller municipalities are not large enough to reach scale economies in service areas on their own and can only achieve the financial gains of scale economies by operating the services in partnership with other councils (Dollery, Crase and

Keefe, 2007). Large municipalities, however, produce most services themselves and usually do not outsource services to private firms (Dollery, 2003).

The opinion on economic efficiency arises from the value of water. The value of water might be well-defined in relation to resource cost, opportunity cost, and social cost. The resource cost is the cost of providing water itself, while the opportunity cost is the value of that water in its best alternative use (Brennan, 2002).The cost varies depending on the particular situation of an area, with areas where there is abundant water incurring a low delivering cost. Under normal circumstances the transmission and storage of raw water is subject to economic of scale. This is not the case in a number of cities. Most households in developing countries are charged low prices for water and sanitation services (Whittington and Hanemann, 2006). The OECD (2009) states that water should be allocated to maximise benefits where the benefits are less than the cost. Such investments have to be avoided and there is need for investment in water infrastructure as this will reduce the ineffective water use.

2.25 THE DEMAND FOR WATER

The demand for sanitation is lower than that of other services including water services. The demand services can be created with a collection of rewards and sanctions, an affordable mix of technologies, and a long-term strategy of engagement and promotion (World Bank, 2011). Regularity in the use creates relations amongst consumers and increases the ability collectively demand for service advancement. Demand for drinking water is frequent and predictable. However, unity of demand may be undermined by the variety of legal and illegal sources of urban water supply and the associated disputes (Batley and Mcloughlin, 2015). Demand-side measures include voluntary and mandatory use restrictions, conservation education programs, price changes, and investment in water-saving equipment and appliances. Supply side measures include the provision of emergency supplies, alternative water sources, and that of recycled water (Ding et al., 2010).

The household demand for water can be divided into indoor and outdoor uses. The assumption is that indoor water uses, such as washing, drinking and sewage drainage, are more elastic than

outdoor water uses that include car washing and the watering of gardens. An indoor use is known as a basic need. Empirical studies in South Africa have found that price elasticity of demand for short term water is less than one, that is, inelastic (Meyer, 2007). The inelastic demand for water supply and the provision for services is very capital intensive thus leading to the creation of a monopoly power rather than welfare. The price elasticity for low amount of water is less, and the delivery of services is in fact capital intensive. This tells that profit can be maximized through the control of capital assets. It promotes monopoly profits rather than the public welfare (Whittington and Hanemann, 2006). Finally, the demand for water is dependent on maintenance, investment, management, and water pricing (Benson and Clay, 1994). Good accountability is vital in securing delivery and accessibility of sanitation investments (The World Bank, 2011). If the median voter demands better sanitation services then better sanitation services are expected and should be prioritised by the locally-elected political leadership (Boex and Edwards 2014).

People's perceptions on their own wellbeing are influenced by the consumption patterns around them. A rural rich person may be comfortable with collecting water from a communal tap or from a well. However, if the starts to compare themselves with city people they will be unhappy with such a situation (Goodwin et al., 2008). Consumers sometimes have less choice regarding some services than others, and have less influence on how the services are delivered. Piped water has restricted choice between alternative providers (Batley and Mcloughlin, 2015). Some economists assume that every person has similar utility functions, categorised by diminishing marginal utility. Some economists, in their comparison of two inhabitants with the same overall level of consumption patterns, concluded that a society with a more equal distribution would have a higher social well-being than a less equal one (Goodwin et al., 2008).

Decision making and enjoyment of consumption at household level may include more than one individual. Adults may negotiate about what to produce or purchase. Many goods and services are also consumed by other persons (Goodwin, Nelson, Ackerman and Weisskopf, 2008). In addition, an individual decision maker makes choices for himself or herself or on behalf of his or her entire household (Goodwin et al., 2008). Nevertheless, inadequate consumption is not only a matter of having a low household income, as some kinds of absolute deprivation can exist even when there is wealth. Well-being depends on the link between resources and needs. Young

children and the ill and handicapped have dependence requirements for care, and needs for special goods and services that the healthy and prime-age adults do not require. Even people with fairly high household incomes might sometimes find themselves in a condition of lack (Goodwin et al., 2008).

2.26 THE COST OF WATER

The cost of goods influences the ways goods are consumed. Several factors including the cost of producing water, water-rate structures, and sewage charges have an influence on the final costs of goods (Marella, 1992). Decreasing the block rate results in a decrease in unit charges as customer s would use more water. An increasing block rate increases charges as customers use more water; and a uniform rate remains fixed irrespective of the quantity used (Marella, 1992). Most households with drinking water also receive wastewater service and as such the cost of discharging can also influence the pricing of drinking water (Marella, 1992). Thus, the basis for water prices includes full supply costs, full economic costs and full costs. Full supply costs take into account the operation and maintenance costs and capital charges for the development of the supply system. Full economic costs take the opportunity costs and economic externalities into account and environmental externalities. Opportunity costs arise in cases of conflicts in water allocation (Echternacht, 2014). Welfare is maximised when: water is priced at its marginal cost, and is used until the marginal cost is equal to the marginal benefit. Markets reflect marginal values, and function when values are relatively stable. In some cases, the marginal utility of water is essentially infinite (Perry et al., 1997).

According to the OECD (2009), the water sector requires funding revenues from the 3Ts, which are tariffs, taxes and transfers from donors. Tariff revenue is important for cost recovery. Recuperating operation and maintenance costs is significant; without it infrastructure will collapse. However, using tariffs to recover the full costs of water supply and sanitation and for investment and major rehabilitations is not easy even in developed countries. According to the OECD (2009), the degree of subsidised poor populations decreases the effectiveness of any tariff structure. The OECD (2009) notes further that affordability restrictions are well evaluated at the local level and should take into account local knowledge on low-income households with regards

to their current spending on services and ability and willingness to pay for improved services. Keeping tariffs low may stop the extension of services to those households who are currently not receiving services and is not an effective measure to assist the poor.

National budget funds might subsidise a part of local wastewater treatment and the pro-poor delivery of urban sanitation services in order to make sure a balance between costs and benefits (Boex and Edwards, 2014). Political dynamics are vital in local service delivery funding decisions, while local fiscal dynamics is important in determining how public funds are allocated. In particular, the way in which local sanitation infrastructure and services are funded has a vital effect on the level of local sanitation expenditures (Boex and Edwards, 2014).

2.27 DECENTRALISATION

This subsection demonstrates the rationale for provincial and local governments (municipalities) in particular to take charge of service delivery in general which is also relevant to water supply and sanitation provision.

Decentralisation reduces the costs of making choices. Fiscal decentralisation encourages public participation in the making of decisions as local government and provincial government are nearer to communities and can foster fiscal accountability. A financial stabilisation policy would be in-effective in provincial and local government (Black et al., 2008). Decentralisation can also be a testing ground for innovations. Central government is critical in inspiring innovations by offering appropriate incentives and an enabling environment, monitoring and evaluating performance on the basis of outcomes, harnessing the lessons learned for the benefit of other local governments, and intervening when services fail. Thus, decentralization, who main objective, as stated the World Bank (2011) is to reinforce citizen voice by bringing services and elected politicians closer to the citizens, can assist the governments to reply better to local conditions and demands.

The desirability of decentralising service responsibilities to lower spheres of government depends on many factors. These factors include the politics, technology of the service involved,

skills required extent of scale economies, intergovernmental fiscal transfers and own-revenue raising capacities as well as the level to which services and clear assignment of roles and responsibilities are made. Decentralisation can inspire user contribution in the implementation, design, and monitoring of services. Policymakers and service providers frequently minimise citizen input because it risks reducing delivery and missing infrastructure development targets. Governments sometimes respond to poor service delivery by recentralising implementation and control. Decentralised budgetary expert can inspire burden from regional government, civil society, and citizens to distribute budget to sanitation investment. On the supply side, decentralisation can have politicians and bureaucrats maintaining contact with constituents. Decentralisation can also prove to be significant in promoting institutional arrangements. Finally, resources are frequently allocated where there are political rewards and government may not have enough pressure to put more resources towards sanitation (The World Bank, 2011).

2.28 THE GENERAL SERVICE DELIVERY

Poor performance is caused by three public provision issues. First is populist pressure towards keeping prices less than the cost even though the subsequent lower cost does not benefit the poor. Second, public enterprises are faced with conflicts of interest because the owner is also a regulator, and as a result performance contracts cannot be credibly enforced. Third, public enterprises are confronted with the non-credible threat of bankruptcy, weak competition, agency problems, rigidities, and performance measurement problems. Poor performance, deteriorating fiscal conditions, and pressure from donors have forced many developing countries to involve the private sector in the provision and financing of goods and services previously provided by the public sector (Araral, 2008). These provision issues lead to the view that some water shortages are a result of management failures and not the shortage of water by itself. These shortages are due to insufficient control of (a) hydraulic facilities; (b) land-use planning in cropping areas; and (c) a result of political interference (Brennan, 2002).

There are more benefits that can be derived from sanitation investment than on water. The reality is that the availability of adequate water supply does not stop the risk of spread of infections especially if there are no sanitation services. Poor water and sanitation pose serious

macroeconomic risks for travel, tourism, trade and investment. Improved water and sanitation services can serve as insurance for macro-economic shocks (Whittington and Hanemann, 2006). Increasing the quality of water access and sanitation is therefore, a necessary condition for associated incremental health improvements although perhaps not sufficient (Rhodes and McKenzie, 2015).

Efficient and clean resource management is very significant. Measures of corruption and poor governance are associated with per capita income and with the Development Index (HDI). Richer countries usually have less reported corruption and better functioning governments (Rose-Ackerman, 2004). In addition, water resources management and water supply and sanitation service provision ought to attract capital, skills and technology by adequately compensating them (OECD, 2009). This shows the need for market related tariffs, the reliability of their automatic adjustments and their flexibility in adjusting to changing circumstances in order for financial sustainability to be achieved.

Most economists' policies on urban water supply can be shortened as follows (1) urban water supply should be treated as a private good and priced to cover costs, including investment and externalities; (2) utilities should be operated under state regulation (3) poor consumers should be subsidised through means-targeted subsidies; (4) management of water utilities will be more efficient under private operation; and (5) various forms of competition could further spur efficiency (Araral, 2008). People want Public Services to help them but judge the ability of government to serve using wider and more difficult factors. Instead, people need to be pay attention to and place value on mutual trust. If people do not feel that the government is broadly accountable, they will not feel that it is accountable and responsive in providing services. The spate of local protests further indicates this feeling. The urban poor are thus concerned with lack of service and how they are excluded from certain urban spaces (World Bank, 2011).

Publicly delivered water and sanitation services generally fail neither to deliver efficient services nor to reach the poorest. This brings in the need for a water and sanitation strategy that recognises and is built around the centrality of private provision (Bosch, Hommann, Rubio, Sadoff, and Travers, 2002). There however are several limits to the privatization of the provision

of water. The limits are: (1) private investment in water is relatively minor compared to total private investment in the infrastructure sector; (2) private investors prefer doing business in middle-income countries than in low-income countries; (3) more than one-third of all private investments in the water and sanitation sector worldwide, became distressed or were cancelled or renegotiated, including those of the largest concessions (Araral, 2008). In addition, outside effects are of primary concern to local citizens (Dollery and Wallis, 2001). The provision of drinking water is subject to a distribution infrastructure and the construction and maintenance cost need a lot of money. It appears that there is no certain theoretical reason why government provision on its own should be either equitable or inequitable in terms of distribution of the commodity being provided (Grand, 2014). However, the Water Services Act promotes the equity in delivering services.

The provision of services involves governance issues. Governance involves the implementation of economic, political and administrative authority to manage the affairs of a country. It comprises mechanisms, processes and institutions through which citizens and groups communicate their interests, exercise their legal rights, meet their obligations and mediate their differences (Kamara et al., 2012). Preferences are difficult to determine. This leads to an overestimation of gains and underestimation of costs. In addition, it makes politicians to vote for provisions that are higher than the efficient level (Grand, 2014).

The mix of municipal services depends on the council's ability to identify what should be done. By comparison, the burden of local government service delivery is gauged according to its efficiency, and measured by the average cost of services and effectiveness of service provision (Dollery, 2003). Municipalities may deliver different kinds of services, this makes monitoring and accountability so a serious challenge. Contracting the private sector to provide services should be based on cost and feasibility (Dollery, 2003). Administrators must understand infrastructure and services delivery issue. Citizens can easily influence decisions while it is also easier for small councils to satisfy community needs (Dollery, 2003). Nonetheless, sometimes there is need for inter-municipal cooperation, which includes agreements or joint production between local governments, as a means to gain economies of scale, advance service quality, and

promote regional service coordination across fragmented local government regions (Bel and Warner, 2015).

2.29 AGRICULTURAL WATER USE

One of this study's consideration in chapters four and five is whether frequent water disruptions (irregular water supply) is caused by water demand from the agricultural sector, since the Free State Province has a significant agricultural sector, hence the following literature review considers the tension between agricultural and urban water demand.

The agriculture sector is a dominant water user. The political costs of moving water away from this sector are high (Brennan, 2002). The opportunity cost of water used in agriculture is much lower than the value of water for its highest consumption in urban and industrial use, even if one only considers raw water and excludes the cost of treatment (Van Der Zaag and Savenije, 2006). According to the OECD (2009), farmers require additional advice on best practices. Whereas the opportunity cost of water for domestic water use might be highest, the moment availability is higher than demand leads to a reduction of the opportunity cost of the water owing to the next best type of use (Van Der Zaag and Savenije, 2006). The reality that irrigated agriculture is a leading user of the water resource has resulted in the level and efficiency of water used in this sector being subjected to an improved analysis. Competition with other sectors can suggest that less water is obtainable for irrigated agriculture in water-scarce regions and raises the importance of improved efficiency of water use within agriculture (Brennan, 2002).

Generally, the agricultural sector has political power and as such any reform that that impacts on the farmers access to water also affects the wealth of farmers, and will be resisted (Brennan, 2002). There is sizable opposition to transfer of water out of irrigation districts because it is understood that the trading will have a negative impact on the secondary influence on the aquifers and distribution of recycling (Perry et al., 1997). According to the OECD (2009), the principles of sustainable cost recovery should be applied on agriculture water use as well and yet farmers often only cover the operation and maintenance costs for water supplied, with little or no recovery of capital costs for water delivery infrastructure. When the agricultural tariff increases

and more water become accessible to the other two sectors, the opportunity cost of agricultural water will decrease. As more water becomes obtainable, the reduced capital and pumping costs will cut the cost of industrial and urban water (Rogers, De Silva, Bhatia, 2002). If water is valued with a positive marginal cost, farmers will resolve to substitute some labour for water and in doing so decrease the amount of water and yield what looks like real water savings. But these savings are eventually illusory as long as the excess water is recycled and reused (Perry et al., 1997).

2.30 DROUGHT

Drought is one of the key variables used in chapters four and five of this study; hence it is useful to provide a succinct account of its impact water supply.

Droughts have a range of shocks, the nature and magnitude of which depend on circumstances particular to each country. For example, declines in relative water-intensive output may constrain output in sectors and sub-sectors linked to water-intensive industries. Changes in rainfall affect the storing of water in natural and artificial surface and sub-surface storage systems. In addition, external streams may have a broader influence, dependent on the water intensity of other sectors (Benson and Clay, 1994). Drought also causes significant economic effects in non-agricultural sectors such as tourism and recreation, public utilities, horticulture and landscaping services, navigation and other industries or businesses that have noteworthy water consumption (Ding, Hayes and Widhalm, 2010). Droughts lessen the water available for household consumption and may also have long term implications for income distribution if there is widespread scale sale of assets by lower income households. Households may sell their assets and this in turn has implications on other sectors such as education in some countries (Benson and Clay, 1994). Hence, droughts have a huge impact on the social and economic health of the affected country.

The nature of the existing water resource management plays a significant role during a drought season/s. Poor water resource management leads to an intensification of the impact of drought (Benson and Clay, 1994). The ensuing water supply shortages compel water services institutions to draw drought management policies. The drought management policies will inform the

education and awareness programs, pricing and quantity restrictions. The policies also affect residents and commercial consumers. The size of water supply cutbacks, water management strategies that would be adopted by water agencies and the nature of consumer response to policies determine the effect of drought on consumer welfare. Nonetheless, the drought management restrictions do not affect every consumer and those that are affected are worse off and this leaves some consumers willing to pay to avoid these restrictions (Dixon et al., 1992).

2.31 CONCLUSSION

Politicians tend to favour above ground infrastructure at the expenses of underground infrastructure like water pipelines. Politicians are also biased towards to services provision where they can provide to one community without providing to the other. When the provider has more discretion, it shifts the balance of power away from policy makers towards the providers or contractors (Batley and Mcloughlin, 2015).

Appropriate operation and maintenance ensures sustainable service provision. Operation involves the monitoring of the state of the system, administration of the system and ensuring compliance. While maintenance is about condition assessment, restoration servicing and replacement of system components (van Zyl, 2014).

The cost for the maintenance of infrastructure should be estimated rigorously. If the predicted cost is too high, the community will not afford it; if the estimate is low and the water system is constructed, there will be lack of funds for its operation and maintenance. Therefore, many estimators place an additional amount to for the unforeseen costs and inflation (Jordan and Wyatt, 1989). In addition, if repairing costs are greater than the replacement cost, the pipe will be replaced.

The above literature review also shows that limited information on the quality of service provision compels consumers to undervalue the benefits of the service rendered (Dollery, 2003). This then underscores the need for clarity on who is responsible for a certain service as this assists society in its attempts at holding government officials accountable (Boex and Edwards,

2014). Nonetheless, citizens' failure to identify their own interest or that of the public leads to a market failure (Batley and Mcloughlin, 2015).

Individuals are usually satisfied with receive services as long as it is equivalent to services received by the persons near them, even though it may not reach the basic services standards (Goodwin, Nelson, Ackerman and Weisskopf, 2008). The demand for sanitation is less than that of water, as a result, the demand can be improved through awareness campaigns and promotions (World Bank, 2011). There are more significant benefits that can be accrued from sanitation than from water services, for as noted by Whittington and Hanemann (2006), lack of adequate sanitation creates the risks for the spread of diseases and undermining of other sectors such as tourism sector, trade and even investment.

It can also be deduced from the literature review that service provision can be improved through various means. Persons from smaller municipalities can easily hold the policy makers accountable as they have better access to them. This unlike in situation existing in large councils where there exists a potential to enjoy economies of scale and yet the potential is not used (Dollery, 2003). In addition, decentralisation may reduce the cost of decision making and thus encourage public participation (Black, Calitz and Steenekamp, 2008) and ultimately service delivery. This significance of decentralization is confirmed by the World Bank (2011) in its observation that condition enables authorities to respond easily to the demands of the local community. The reality is indeed that, policymakers and service providers do not adequately consider the inputs from citizens as they strive to meet their infrastructure goals, hence the need for decentralisation.

The water and sanitation conditions of any country have been noted as vulnerable to nature and thus needing infrastructure development and the introduction of means to limit the shocks from water shortages. Droughts affect countries differently, but generally a fall in relative water-intensive production affects the output from the sectors that are dependent on water (Benson and Clay, 1994). As a result, investing in water and sanitation infrastructure protects any economy against water-related shocks. Investing in water and sanitation also reduces the cost of water and improves its quality. Incidentally, water and sanitation is critical to any society's health and

economic growth. Poor water and sanitation have been observed as impediments to employment creation, skills development and the limiting the realisation of income (Sanctuary et al., 2004), for as noted further, a decrease in the price of water implies a fall in output prices (Schwartz and Johnson, 1992).

Hence, maximum economic growth is achievable through a socially efficient utilisation of water (Barbier, 2004). Leakages and illegal water makes the economy to operate below its potential. In addition, an increase in water supply infrastructure ensures the availability of more water for commercial and industries and increases the amount of water goods that can be produced by the economy (Schwartz and Johnson, 1992).

CHAPTER 3

3. EMPIRICAL LITERATURE REVIEW

3.1 INTRODUCTION

The benefits for investing in water and sanitation supply exceed the costs in whatever scenario one may consider (Sanctuary *et al.,* 2004). According to Heleba (2009) many urban areas have unreliable water pipes and unaccounted connections and encounter supply disruptions and lots of leakages. Ginster *et al.,* (2013) suggest that the reality in such a situation is that, municipalities play a role in increasing water losses through poorly maintained infrastructure within their water connections and inappropriate management of assets. Municipalities usually prioritise the setting up of infrastructure at the expense of investments in maintenance or recurrent costs (Batley and Mcloughlin, 2015). Nonetheless, Ginster *et al.,* (2013) argue there are other factors, such as ageing infrastructure, leakages and cable thefts that been the cause of water supply problems in places such as Brandfort in the Free State.

The provision of access to services differs with each country in Africa. In Africa, more 50 percent of households do not have access to systems from local government that allow them to dump waste from their households. Traditional pit latrines are the mostly used form of sanitation in Africa. The consumption of water per person is 47 liters in Africa, compared to 95 liters in Asia and 578 liters in the US (Banerjee *et al.,* 2008). An indigent policy was, however, adopted by the South African local government to provide free basic services for water, sanitation and refuse removal to those who cannot afford to pay for them (Heleba, 2009). As such, South Africa stipulates that 6,000 litres, which is equivalent to 25 litres per day, will be provided every month for free to everyone (Jagals, 2012). However, an increase in population and reduction of household size makes it difficult to achieve water connections for all households. The average African household appears to become smaller as incomes increases (Banerjee et al., 2008). In addition, rising income is associated with piped water supply (National Treasury, 2011). In Africa, however, countries such as Nigeria have high income but low infrastructure coverage (Sanctuary *et al.,* 2004). The poor have little economic capacity to invest in environmental infrastructure such as tanks, piped water, and flash toilets (Tanyanyiwa and Mutungamiri, 2011). Notwithstanding development in service provision for the poor, there are still people without

services in the poorest districts and some rural areas in South Africa, for, as noted by Heleba (2009) in 2005, 50 percent of the poor did not have their own pipes. Nonetheless, urbanised countries and even their rural areas have better water infrastructure (Banerjee et al, 2008).

Countries with better storage capacity tend to have better economic growth. Despite that, some nations in Sub-Saharan Africa have to invest up to $700 per capita in order to have water storage equivalent to that of South Africa. Big cities tend to be better in expansion of infrastructure than the small urban areas and rural areas. The high demand for water in South Africa has been influenced by the eradication of the bucket system (Sanctuary *et al.,* 2004). Furthermore, the number of engineers has fallen dramatically since 1994 in South Africa (National Treasury, 2011). In addition, the three spheres of government appear to prevent the use of scarce skills in another sphere, because each sphere protects its own staff (Hogg and Samson 2011).

An improved water and sanitation investment contributes positively to economic growth (Sanctuary *et al.,* 2004). Empirical evidence mentions that businesses like guest houses, in places such as Corolina in the Mpumalanga Province of South Africa, lost many clients as a result of water contamination (Tempelhoff, Ginster, Motloung, Gouws and Strauss, 2012). According to Sanctuary, Tropp and Berntell (2004), empirical evidence also reveals that, water quality that is comparable to international standards and dependable water supply and sanitation are important for the success of the tourism sector Poor water and sanitation results in economic costs associated with treatment costs and loss of income through reduced or loss of productivity. It also leads to the loss of time and poor product quality owing to the poor quality of water. Poor water and sanitation can also lead to a reduced productive value of agriculture and fisheries. Instead a better water supply and water resources management and sanitation enhances the economic growth of a nation and assist in poverty alleviation (Sanctuary, Tropp and Berntell 2004). According to the DWA (2013), groundwater is the source of healthy water in many rural areas and numerous urban areas in South Africa. Ground water, which is noted by Rathgeber (2003) as associated with the greater use of boreholes in Africa, is also used for the irrigation and for supporting livestock and game.

South Africa's future plans on and present water use patterns are characteristically prone to vulnerabilities. The country has planned to increase irrigated land by more than 50 percent. This is despite the fact that 60 percent of South African rivers flow from 20 percent of the land in the country with the situation made worse by the reality that 8 percent of the land provides 50 percent of the water (NWRS, 2013). This future and even present water scarcity can be reduced by shifting away from water intensive agricultural goods (Butter et al., 2006). Nonetheless, water scarcity is not only natural but also it due to low level of infrastructure investment. There is high wastage and inefficient use of water in South Africa (Butter et al., 2006). As a result, according to Jabeen, Mahmood, Tariq, Nawab, Elahi (2011) an improved public awareness can reduce the service delivery protest actions that are frequently witnessed in South Africa. Service providers are rarely rewarded for successful project outcomes but instead for delivering outputs, as such, they may be less responsive to the voice and power of beneficiaries in order to reward well or punish bad performance (Hogg and Samson, 2011). This may due to the fact that when the citizen raises their voice it is normally against the municipality not the service provider who was appointed to do the project.

Therefore, this chapter will investigate the empirical literature on the water and sanitation target. The review will consider literature focusing on water and sanitation in relation to the millennium development goals, the statement of the Constitution on basic services and expenditure, water supply interruptions, droughts, the dam levels as a results of droughts, public private partnerships, service delivery in South Africa, accountability on the provision of services, infrastructure requirement, skill shortages, pricing of water supply, access to water supply for poor households, and the budget for infrastructure services. The review will also consider social and economic factors such as the effect of water and sanitation on growth, water loss from leakages and theft, population growth, access to water and sanitation on different countries, inequality, female headed households, and the differences in rural and urban access to sanitation and quality water quality. The literature focusing on the water and sanitation target in relation environmental issues such as climate change, water demand and water conservation, water re-use and desalination, agriculture, water scarcity, public awareness campaigns, and the benefits for improved access to water and sanitation, is also reviewed in this chapter.

3.2 THE MILLENNIUM DEVELOPMENT GOALS (MDG)

This subsection focuses on the progress within the water and sanitation towards achieving MDG and touch on the introduction of sustainable development goals (SDG). It considers perspectives on South Africa and the world and also highlights the global financial requirements needed to meet the MDG targets.

An evaluation of the South African and global attempts at meeting the MDG targets for water and sanitation presents varying results, South Africa achieved the global MDG target for water in 2010 but the sanitation one is still to be attained. However, a country-by-country survey shows that many countries failed to reach the target on both water and sanitation. This means that, there are lots of investments needed in many countries (Hutton, 2012). The Millennium Development Goals, Country Report 2013**,** which was published by Statistics South Africa, stated that the country was likely to achieve the sanitation target in 2015. The report also showed that a lower percentage of households in the Limpopo and Eastern Cape s had access to both water and sanitation and thus operating below the country' MDG target.

According to subregion report 2015on sustainable development goals (SDG) for the Southern Africa, SDG have been introduced and are made based on the success of the MDG. 2030 has been set as time where countries are supposed to achieve the SDG. The SDG are simplified and has the potentials of encouraging broader ownership from countries or regions. SDG issues that are associated with each other will be reported together unlike MDG where related issues were reported separately.

The slow progress with regard to MDG target has huge financial repercussions. More funding is now needed to finance both water and sanitation projects. The investment necessities on new services to achieve the MDG is greater than before, such that water and sanitation now need $32 billion per year, largely due to the sanitation component of the MDG (Hutton, 2012). Meeting these investment needs, at country level, is highly feasible in most nations. Nevertheless, an additional annual investment of $11.3 billion is needed to achieve the MDG targets on water supply and sanitation and yet the economic benefit of accomplishing the MDG is $84 billion. Therefore, less than 20 percent of countries are likely to achieve universal access for piped water

by 2050 if the status quo continues (Banerjee et al 2008): for, as noted by SIWI (2004), the annual per capita cost to achieve MDG on water and sanitation in Ghana, Tanzania, Bangladesh, Colombia and Uganda vary from $ 4 to $ 7 per capita yearly.

3.3 THE STATEMENT OF THE CONSTITUTION ON BASIC SERVICES AND EXPENDITURE

The rights that individuals have with regard to water, sanitation and other basic services, as per the country's Constitution are considered here. The Constitution's Section 27(2) affects the provision of water through its stipulation that the State must use its power based on its available resources to ensure that the rights of individuals are realised (Heleba 2009). Thus, the Government is constitutionally compelled to provide or spread basic goods and services such as water, adequate housing, food, healthcare, education and social security (Black et al. 2008). In addition, the Government or Constitution has many provisions to guide the composition of government spending (Black et al. 2008).

Another, legislation, the Water Services Act, proscribes the right to basic water supply and basic sanitation, which sets the minimum supply of services. Chapter II of the Water Services Act, read together with the Strategic Framework for Water Services, sets the standards for the provision of the basic services. As a result, Water Services Authorities responsibilities towards consumers and prospective consumers in their areas of jurisdiction include ensuring that water services are affordable, economical, efficient and sustainable (Algotsson and Murombo, Davies and Poole, 2009).

3.4 WATER SUPPLY INTERUPTIONS

This subsection focuses on water services disruptions and restrictions in the Free State. It also evaluates the influence of ageing infrastructure on water loss. It highlights the empirical evidence focusing on the effects of disruptions on clinics, hospital, schools and sale of houses in the Brandfort area of the Free State Province in South Africa.

The Free State Province's climate renders the region prone to water scarcity and droughts. The recent evidence was clearly spelt out by the New Age newspaper dated 31 August 2015 in their observation that the Free State was facing low rainfall and drought. The newspaper went on to outline that there were water shortages with Municipalities forced to introduce a 15 percent restriction on domestic and industrial supply and 50 percent restrictions on water for irrigation purposes from the Moeder River. There indeed has been a disruption in water supply in the Free State Province's townships. Poor maintenance, aging infrastructure, power cuts and theft cause water supply disruptions and contribute to water loss (Ginster, Tempelhoff, van der Merwe, Berner, Motloung and Rabali, 2013). The NWRS (2013) also notes that water loss in municipalities is normally greater than 37 percent, with the situation much worse in numerous irrigations and municipal supply schemes as they get predicted losses of up to 60 percent.

Ginster et al (2013) observe that water supply interruptions in areas, such as Brandfort, are an indication that the water security is poses a social and economic threat in South Africa. Ageing infrastructure was the major cause of water disruptions in Brandford Free State. The infrastructure failure is attributed to the inability of the municipality to create enough storage for water in reservoirs. Consequently, the disruption impacts negatively on the provision of healthcare in clinics and hospitals and the schools feeding schemes for poor communities. The severity of the impact of the infrastructure failure was noted in the discontinuation of feeding schemes because of lack of water and closure of the local clinic, a modern building complex, when there was no water. Water supply problems also affected negatively the sales of houses located in the elevated regions.

3.5 DROUGHT SITUATIONS IN DIFFERENT COUNTRIES

This subsection outlines the impact of drought in South Africa. It focuses more on the levels of dams and boreholes and the attention that is given to drought disasters in relation to other disasters. It also evaluates drought management in South Africa and the impact of drought on electricity generation in Zambia and Zimbabwe. Finally, it considers the water conditions in one of the driest countries in the world.

Droughts make it difficult for the poor to access food. Approximately, 2.5 million people were critically affected between January and March 2016 in Zimbabwe, Malawi, Mozambique, Lesotho and Madagascar as a result of drought. Continuous hot and dry conditions continue to reduce food yields in northern South Africa, northern Zimbabwe and southern Zambia (van Zyl 2016). AgriSA (2016) reveals that the impact of drought is severe on maize, wheat, sugar, beef and sheep. It is estimated that 83 percent of maize, 53 percent of wheat and 73 percent of sugarcane are produced under dry condition. The 2016 rain fall season has been the driest in three decades with prolonged lower rainfall and drought conditions experienced across the country (van Zyl 2016). Droughts emergencies were declared during the 201* season in various provinces in Lesotho and South Africa (van Zyl 2016). However, a state of drought disaster was declared in only two of South Africa's nine provinces, which are the Free State and KwaZulu Natal Provinces (Balzer 2016).

Droughts tend to attract less attention unlike floods. Even though the impact of drought are likely to be worse as it happened in Bangladesh (Miyan 2014). The Bangladeshi case is instructive here as 2 million small farmers and 2.4 million rural wage laborers were affected. In addition, more than 90 percent of the big streams in the hills lost their flow in the dry monsoon resulting in a serious water crisis for hill people who in turn resulted in the outbreak of diarrhea, dysentery and cholera (Miyan 2014). Droughts in Bangladesh also affect plant growth and this has led to a fall in crop production and an increase in poverty and food shortages. Poor households and the northern part of the country were affected the most during the drought of the 2001 season (Miyan 2014). In another case, Yemen, one the driest countries in the world, has had an excessive withdrawal of ground water for years resulting in the drying up of the aquifers in 201*. Many major cities do not have enough safe water and agriculture is threatened, wells are now drilled as deep as 2600–3900 feet and Sana could be the first capital city in the world to run dry (Miyan 2014).

The Department of Water and Sanitation developed robust operating rules for all of the major dams that are used to determine the need for water restrictions where dams' levels are measured. Restrictions are used to prolong water supply during periods of water shortages and reduce or stop the usage of water for less critical purposes (Balzer 2016). South Africa, Swaziland,

Botswana, and Namibia advised their citizens to limit water usage because of low dam levels. The drought experienced during … resulted in low dam levels. Irrigated crops are under pressure. Such pressure arises as a result of lack of sufficient water, high temperature and restrictions (Agri SA 2016). Low level of the amount of water in Kariba Dam effected electricity generation in Zambia and Zimbambwe. The electricity subsequently affected the industries and households income (van Zyl 2016). According to the Drought status report (2016) from the South African Department of Water and Sanitation, the low rainfall and stream flow have caused storages to drop to their lowest levels. The number of dams which are measured on a weekly basis is 211 and dams were in a positive water balance at 53.1 percent of full capacity on 20 June 2016 while on the same day in 2015 the positive water balance was 75.4 percent (Balzer 2016). Dams in the North West Province had the lowest storage compared to other provinces, with Swartruggens and Lindleyspoort Dams reaching the dead storage. Finally, in other cases, drought caused a reduction of agricultural exports in Russia in 2010, while food shortages and price increases raised tensions in the Middle East for food prices increases as a result of drought, as noted by van Zyl's (2016) observations regarding the drought led 15-40 percent increase in the price of maize in Middle East in 2010.

Investors have a significant interest on the potential risk exposure to water-related problems (Morrison, Morikawa, Murphy and Schulte 2009). The growth of China and India is already limited by reduced ground and river water supplies (Morrison, Morikawa, Murphy and Schulte 2009). According to Agri SA (2016), the drought has led to a year-on-year fall in agriculture sector GDP by 18 per cent in first quarter of 2015, 19.7 per cent fall in the second quarter and 12.6 in the third quarter. As a result, the levels of investment in the South African agricultural sector become severely limited owing to the financial risks posed the persistent drought.

According to the Department of Water and Sanitation (2016), the Free State region covers the water management areas (WMA) formerly known as Upper Orange and Middle Vaal. Ground water levels have been declining in the Upper Orange WMA when compared to the previous year, and this could be attributed to an increase in groundwater exploitation and lack of rain. There is also a continuous drop of borehole water levels in the Middle Vaal. This drop is attributed to activities such as irrigation during crop production seasons and seasonal changes.

Bangladesh may face similar drought effects like Yemen due to continuous withdrawal of groundwater. The withdrawal of ground water is forcing the water table to go down and is creating further crisis of water and increasing vulnerability of earthquake, especially in the cities where water table is going down by more than one meter every year. More than 5 million people of the Barind Tractare under a great threat due to severe impact of drought forcing use of arsenic contaminated ground water (Miyan 2014).

3.6 THE SITUATION REGARDING PPP

This part evaluates the government requirement for PPP in terms of National Development Plan (NDP) and it will talk of trust issues. It further articulates the role private sector play with regards to transparency in water challenges. Examples success and failure of PPP are highlighted.

The NDP emphasises the need to develop effective partnerships between public and private sector players for the achievement of Vision 2030. South Africa had an illustrious history of co-operation with the private sector even before the introduction of the NDP. As stated in the NDP, this coordinated method is supposed to be interdependent and interrelated to other departments, spheres of government, the private sector, civil society and the citizens. The approach should also ensure the delivery of a sustainable water supply (Mokonyane, 2017).

The private sector delivers water and wastewater services to more than one billion people over the world (Naidoo, 2017). Nonetheless, majority of consumers are served by the public sector. Public finance remains the main source of funding the improving of water and sanitation delivery. However, the role of public-private partnerships in service delivery and financing of water supply and sanitation infrastructure remain important (Mokonyane, 2017).

According to Naidoo (2017), it appears that the public and private sectors in South Africa are leaders in developing collective action partnerships that allow a trust-building environment for sustainable public-private-civil society partnerships. However, there is still need for addressing

the trust between the public and private sector. An example of a collaboration that allowed trust is that of Mine Water Coordinating Body in the Mpumalanga South Africa and municipalities. Mine companies and local government partnered in an effort to reduce pollution effects from mining. In addition, initiatives such as Expanded Public Works Programme, Jobs fund and the National Skills Development Strategy increased collaboration between the government and the private sector (Mokonyane, 2017). Models of collaboration are more than just private sector complying with regulation and delivering on water management contracts. Corporates in South Africa that are working with the Department of Water and Sanitation and other stakeholders are coming up with innovation on irrigation water management system to save water. At present an amount of 55 million cubic meters of water was saved, which is equivalent to 50 percent of water consumption in NelsonMandela Bay Municipality. About 40% of public-private contracts are cancelled early in Africa. Trust is a huge obstacle for public-private partnership. Contract sophistication may not substitute trust required for public and private organisations work well together.

The challenges on maintaining services provision and financial limitation have forced governments to look for alternatives for services delivery. PPP has been a success in Kenya in terms of quality, leverage, affordability and customer services. Private sector participation shows the challenge of infrastructure is less exposed when kept only with the public sector. The private versus public debates focuses on large corporations and as such, overlooks small companies (OECD 2007).

Private sector participation in Latin America assisted in improving utilities' connections, labor productivity and service continuity. Water and sewerage services have primarily benefited lower income groups. By contrast, the contracting of water services to private consortiums led to negative outcomes in Indonesia. The public operator failed to negotiate comprehensive service agreements and to manage the private contractors efficiently. Other problems included a lack of clarity of roles, an inadequate incentive structure and an unclear bidding process in the selection of contractors (Hogg and Samson, 2011).

3.7 THE SITUATION OF SERVICE DELIVERY IN SOUTH AFRICA

This subsection focuses on areas that are dominated by poor services provision in South Africa. It also considers South Africa's commitment to increase access and set up infrastructure and maintenance at local government. It also reviews the effect of limited managerial and technical skills in municipalities.

South Africa established effective systems which include the democracy. The country's major systems include the constitution and its mandates for the decentralisation framework, basic services provision, the intergovernmental fiscal system, Sector-specific legal and policy frameworks and a vibrant civil society and the Batho Pele principles (Hogg and Samson, 2011).

Poor services delivery is predominant in the former homeland areas and yet there is a commitment to ensure that everyone has access to water and infrastructure in South Africa. However, quality, sustainability and maintenance have not been robust (Hogg and Samson 2011).

Addressing water and sanitation problem is critical in numerous municipalities. The approach is top-down, state centric, supply led, target driven, sometimes fully subsidised and generously funded. This favours capital and skill intensive methods that make the skill shortage worse. In addition, most municipalities in South Africa have chosen in-house municipal service delivery rather than contracting, which raises the risk of service failure, with the condition worsened further by increasing liabilities and the undermining of infrastructure sustainability (Hogg and Samson, 2011). A similar case from the African continent is evident in the various challenges that Kenya faces with regard to water supply and management. These challenges include high volumes of unaccounted for- water, frequent water shortages and wastage, illegal connections, mismanagement of funds, non-payment of water bills and meters not read (Hogg and Samson, 2011).

South Africa has, however, made tremendous progress towards the creation of a constitutional framework for decentralization. The country has come up with racially diverse municipalities

and provinces that replaced the previous racially-based local jurisdictions. Decentralisation gains from the tremendous intergovernmental fiscal system, but municipal capacity varies. Lots of municipalities struggle to appeal to people managerial skills and technical skills (Hogg and Samson, 2011). In the meantime, municipalities endure the effect of service dissatisfaction, even from those whose services they are not in control of (Hogg and Samson, 2011).

According to the NWRS (2013), there is slight private equity and investment in water infrastructure in South Africa. The UNEP (2010) also notes that sanitation investments have lagged behind water supply by nearly a decade. Poor economic performance that is linked to financial and technological limits accounts for prevalent inadequate sanitation services.

Technologies that are based on natural treatment processes have moderately lower environmental influence than membrane constructed technologies. Membrane based technologies consume more electricity and has more environmental impacts (Memon, Zheng, Butler, Shirley-Smith, Lui, Makropoulos and Avery 2007). Countries may use the same technology but differing in terms of effectiveness. For instance, similar steel cost thrice to operate in Nigeria compared to South Korea. Once it functions it is partially productive as is the case in Nigeria. However, an increase in capital and technology may alter the less developed countries from being labour demanding to capital demanding goods (Nafziger, 2012).

3.8 ACCOUNTABILITY IN SOUTH AFRICA

The importance of accountability and its influence on different communities is discussed here. The subsection also considers the marginalisation of the poor and informal settlements, challenges with regard to monitoring and evaluation and the in which service providers are rewarded. It evaluates the advantages and disadvantages of decentralisation on economics of scale.

Accountability relations right is important to improving public services delivery for the poor. It means that accountability relationships are entirely working properly and strengthening each other as a public service delivery system. The fact that 90 percent of public spending is done by

national agencies, shows that the ability of people, particularly the poor, to exercise the short route to accountability is limited (Hogg and Samson, 2011). The poor have a narrow scope to complain even though complaining makes the provider accountable to consumers. In rich countries, individuals get help from law and consumer protection offices or government-sponsored ombudsmen, which is rare or nonexistent for the underprivileged in developing countries. In South Africa, customer complaints desks are helpful for the literate individuals only. Several countries have used a citizen report card or citizens' evaluation, a card that collects citizens' opinions about one particular service or a range of services, to establish a monitoring and sanctioning relationship of accountability between citizens and service providers (Hogg and Samson, 2011). The poor members of a community are not always able to articulate their concerns about environmental and other problems owing to a lack of access to official education and training. Such individuals have a lesser level of awareness about the reasons and answers to environmental problems (Tanyanyiwa and Mutungamiri, 2011). However, studies carried out in Ghana showed that villagers who had acquired an understanding of good hygiene habits from training on hygiene did not implement the knowledge afterwards (Balint, 1999). Despite the Ghanaian case above, the improved outcomes realised from listening to the poor and other community's concerns will likely create political "wins" that would lead to political commitment to reforms.

The improvement of accountability and the resultant improved services can only be achieved after reforming the public service. In most cases, public service reform is difficult due to the fact that large numbers of frontline service providers, such as teachers and nurses, need to make many context-specific actions and decisions, which are difficult to monitor and control centrally. This contrasts with macroeconomic management, which can be accomplished by a small group of technocrats. Thus, the challenge that public sector reform faces relates to finding ways that give frontline providers incentives to do their jobs well without intensive central monitoring. Reforms of states' internal organisational structures and public management systems in Latin America, for instance, have led to some improvement in capacity for core economic management of fiscal adjustment, macroeconomic planning, financial management, and tax administration, but more fundamental improvements to state systems have proven more elusive. However, the

record of reform in developing countries is mixed. In South Africa, reforms have met equally mixed results (Hogg and Samson, 2011).

The lack of accountability from service providers has an impact on service delivery. Service providers are rarely rewarded for successful projects (outcomes) but are instead rewarded for delivering outputs and inputs, as a result, they may be less responsive to the voice and power of beneficiaries' to reward good or punish bad performance. Hence, accountability between service providers and beneficiaries is limited. The awareness, by the South African government, of the problems of output-focused silos, compelled it to promote "joined up service delivery systems," which focus on outcomes (Hogg and Samson, 2011).

The South African society is divided between the organised and those who lack the means to organise; some are given a route to hold officials accountable while others are denied this route. The government ought to make efforts to interact with citizens so that it can inspire a sense of political effectiveness, particularly with the previously disadvantaged. Citizen act ought to improve service provision accountability and not create a difficulty to it. South Africa's parliamentary democracy, in collaboration with a free press, permits citizens to use significant power over policymakers and express their views. Changing electoral systems will not be sufficient to the extra fundamental matters of party-political accountability that are at play. The existing service delivery paradigm has undermined citizen choice on services that are needed and how they have to be supplied. Provincial and local governments serve as carry out agencies of the national sphere of government rather than as institutions responsible to their local residents. In addition, widespread informality and government reactions can erode accountability. For instance, shack-dwellers often do not enjoy an automatic right to be heard because their residence or other aspects of their status are technically illegal and in that way weakening their ability to hold the government accountable. Communication with all citizens, particularly with the poor and those living in informal settlements, must be institutionalised to ensure that all citizens feel truly empowered politically. International experience shows that technocratic public sector management reforms in a context characterised by a weak voice and a political system that has a weak accountability between citizens and policymakers leads to largely ineffective improvements in the accountability system. However, linking public sector management reforms

with better outcomes unlike with better input and output management is most likely to yield better services and accountability (Hogg and Samson, 2011).

Decentralisation involving large transfers has worked well across many sectors globally. [In Chile, the education delivery responsibility was transferred to municipalities after the responsibilities, rights, and obligations of the new providers had been clearly defined. Central resources allocated to municipalities were linked to increased numbers of students attending class. Economies of scale also affect decentralisation in important ways. For instance, a network service, such as water supply, is characterised by economies of scale in its management that include water quality assurance and chlorination. These economies of scale were sometimes lost when many Latin American countries decentralised water services to municipalities.] Similarly, in South Africa the rapid decentralisation of waste water treatment to municipalities has compromised water quality in the poorer rural municipalities because of loss of economies in chemical costs and skills (Hogg and Samson, 2011).

Revenue and funding issues play a big role on local government operational activities and service delivery. While total revenue directed to local governments is increasing sharply, the percentage of revenue going to local governments is not. In fact, over 90 percent of the national budget is still allocated to national and provincial governments (Hogg and Samson, 2011).

The Equitable Share "unconditional" grant and the conditional Municipal Infrastructure Grant combine to make up most transfers to local governments. Both of these transfer mechanisms are well designed, with the Equitable Share allowing local governments to fully determine how funds will be spent, while Municipal Infrastructure Grants address service and infrastructure backlogs (Hogg and Samson, 2011). Nonetheless, South African intergovernmental transfers show a concerning high level of provincial and local government grant dependency. A second concern is that nearly half the national budget, including high public spending on health, education and housing, continues to flow through provinces (Hogg and Samson, 2011).

Recently, some citizens have drawn consideration to the necessity for public participation through demonstrations and political action. This indicates to the government, the necessity of

effective communication and public participation in South Africa. Merely providing information to citizen-users and holding consultations with them is insufficient towards the creation of a strong accountability link: citizen-users must be able to alter service provider behavior. In many situations, departments mention examples of consultations in which departments only advise customers and stakeholders about services rendered. However, informing is not consulting; consultation must involve the public through a platform that allows the citizens to provide direct views on the level and quality of services obtained. Two of the most important Batho Pele principles that are supporting citizen voice and user power are consultation and redress. Flaws consist of poor senior management contribution in the monitoring of the execution of the principles driving Batho Pele, and an absence of public involvement in the execution of these principles. Hence, public participation needs a confident citizenry that holds officials to account without fear of reprisals such as the withholding of services and benefits (Hogg and Samson, 2011).

3.9 INFRASTRUCTURE REQUIREMENT

The focus here is on the need for infrastructure and its maintenance in South Africa and Sub-Saharan Africa. It highlights the lack of prioritisation of infrastructure maintenance and the link between storage capacity and growth. Finally, the subsection also considers the relationship between good infrastructure and labour productivity as well as the positive externalities of infrastructure.

There is an under-investment in infrastructure in South Africa estimated to be more than R600 billion in 2011 (Ruiters 2011). The estimates for demand indicate that by 2030, the water deficit might be between 2.7 billion and 3.8 billion cubic metres. SA cannot afford to delay the development of new water sources unless water deficit will be exacerbated. The increase in water deficit may cause challenges with regard to water for household consumption, energy, food production, economic growth and sustaining ecosystems (Mokonyane, 2017). The number of households without access infrastructure is too high (Banerjee et al., 2008). Ironically, Sub-Saharan Africa countries have to invest between $150 and $700 per capita in order to have water storage infrastructure equal to South Africa. Nonetheless, Mokonyane (2017) noted that the

South African water sector has been lacking control of large infrastructure projects and investments. The water sector needs to stimulate a diverse and capable water sector business and investment. Current estimates for infrastructure needs and investments over a 10 year period in South Africa vary from R330 billion to more than R1 trillion when including infrastructure maintenance, upgrades and planned initiatives. Banerjee et al (2008) adds that countries that require investment the most are Nigeria, Ethopia and Tanzania while Morocco lacks enough water resources infrastructure. The government has paid $4 billion from 2005 in order to secure safe provisions of drinking water all over South Africa (Sanctuary et al., 2004). Nonetheless, Sub-Saharan Africa is subject to various climatic changes than most other countries and has the least per capita water storage and buffer capacity to deal with life-threatening natural events. A comparison of Sub-Saharan and other global conditions shows that Ethiopia and Australia have comparable degrees of climate variability, yet Australia has 4700 cubic meters of water storage capacity while Ethopia has 43 cubic meters (Sanctuary et al., 2004). In addition, South Africa has 746 cubic meters of water storage while China and Brazil have 2486 and 3255 cubic meters of water storage respectively. Finally, only 5 percent of the world dams are situated in Africa, whereas 33 percent are found in Asia (Sanctuary et al., 2004), thus confirming the state of under-investment in infrastructure in South Africa and Sub-Saharan Africa in comparison to other global countries.

There, however, have been attempts to invest in infrastructure development in South Africa. The disruption in water supply in Branfort, in the Free State, was followed by the Department of Water Affairs project in which is installed new infrastructure. However, there are doubts that the infrastructure would be properly operated and maintained (Ginster et al 2013). Some economists maintain that great investment amounts benefit the underprivileged, because capital buildup increases productivity and typical welfare (Nafziger 2012). Ironically, the putting up of infrastructure in the water sector is frequently prioritised over investments in maintenance or recurrent costs. Predominantly in democracies, low visibility public goods such as sanitation, health or education are expected to contract less voter and political attention than famine relief or defense during war (Batley and Mcloughlin, 2015). There is constantly the danger of market failures in water supply. Because water is bulky and large investments are required (Van Der

Zaag and Savenije, 2006). This may be link to the Brandfort situation where there are needs for investments.

There is higher economic growth in economies where water storage capacity is improved (Sactuary et al., 2004) investors may not be willing to invest in a country with less than enough water storage. However, not all private savings automatically and effectively turn into adequate dimensions of investment, especially in an appropriate investments structure that would stimulate and back justifiable economic growth and socio-economic development (Fronea *et al.,* 2014). In states like Romania growth of public infrastructure is inadequate and postponing economic improvement (Fronea *et al.,* 2014). Romania used to have the highest amount of public investment spending as a share of GDP, while nations such as Hungary, Poland, Bulgaria, Slovenia and Slovakia with lesser investment costs, have a superior infrastructure quality, which proves the low efficiency of these disbursements in Romania. Water infrastructure is an actual match between Romania and the countries in underprivileged regions of Africa and Asia (Fronea and Froneb, 2014).Investments alone may not be enough improve growth, efficiency is necessary for economic growth.

The nonexistence of public expenditure on infrastructure maintenance has been a recurring challenge in various emerging countries, South Africa included. Technical inadequacies in railways, roads, water and power triggered losses in emerging countries comparable to a quarter of their yearly investment in infrastructure in the early 1990s (Agenor and Moreno-Dodson, 2006). The major cities and national capital in South Africa are increasing their infrastructure development at a larger pace than rural areas and small towns. These developments are significant, considering that countries such as Ethiopia, Gabon, Ghana, Zimbabwe and South Africa have about 80 percent of the inhabitants staying in capitals and other major cities and have electricity (Banerjee *et al.,* 2008).Nonetheless, rural municipalities, as is the case in South Africa, face severe infrastructure backlogs while urban municipalities are confronted with rising population increase (Jansen, 2012). The rural municipalities are disadvantaged owing to the fact that, the method in which the Municipal Infrastructure Grant (MIG) is calculated and managed does not permit a maintainable eradication of backlogs in rural areas (National Treasury, 2011). Furthermore, there are still a number of poor households in South Africa that do not have access

to purified drinking water nor access to sanitation (Jansen, 2012). According to the South African National Treasury (2011), government transfers alone cannot address all infrastructure improvements and the provision of basic services to poor households, which indicates why there is a state of under-investment whose resultant infrastructure deficit can be solved through investment financed by revenue from raised tariffs.

The removal of infrastructure limitations, such as water shortages, difficult road access, and especially electricity outages, can facilitate further development and shift private resources to more productive sectors such as manufacturing and agriculture. The NWRS (2013) states that the energy sector's water requirement is about 2%, which is a fairly high water-consuming sector, considering that there are a few power stations in South Africa. Although, Eskom has devoted itself to putting in power stations that will radically decrease the demand for water, the energy sector is exceedingly reliant on sustainable supplies of water for the production of electricity. In addition, the water sector is exceedingly reliant on a continuous and consistent supply of electricity to transfer or move water. This is critical for, as Agenor and Moreno-Dodson (2006) point out, an absence of sufficient electricity sources is a greatest significant limitation to investment. In addition, Ginger et al,. (2013), state that the 2011 water supply disruption in Brandfort was, to a certain extent, attributed to the overall energy crisis in South Africa. However, the main problems are associated with poorly installed infrastructure.

An improved infrastructure is significant for the agriculture sector. Farmers can get inputs reasonable prices, and trade their outputs at high prices. In addition, smoothing road transport and communications can contribute to an increase in workers' productivity. Transport expenses are important in making decisions whether to engage in certain activities or not. For example, China improved investments in infrastructure led higher agricultural output in rural regions, labor mobility, greater flows of labor and capital to town centers and facilitated growth in the services and manufacturing sectors (Agenor and Moreno-Dodson, 2006). Improved infrastructure may increase the supply of investments in a country.

Finally, in Investment in water and sanitation encourages further investment in the industrial and commercial sector. A study from 24 emerging nations puts forward the view that, public

investment in infrastructure tends to lead to an increase in private investment. Evidence from Malaysia indicates that a dollar of infrastructure investment encourages 25 cents of private national investment while that from Turkey demonstrates that private domestic investment rises by 35 cents (Schwartz and Johnson, 1992). Water supply investment will probably attract the highest return in cases where insignificant distributions systems can be extended without going beyond the current capacity (Schwartz and Johnson, 1992). There are also good externalities that are encouraged by infrastructure, as well as improved competitiveness, increased foreign direct investment, and greater regional and international trade (Dissou and Didic, 2013).

3.10 SKILL SHORTAGES

There are more than 1000 vacancies for civil engineers and technicians at municipalities in the country (Styan 2008). The number of people in Nelson Mandela Bay is approximately 1.15 million people, with just one civil engineer. As a result, Nelson Mandela Bay had the highest number of services delivery protests between 2013 and 2015. Local municipalities are now employing technicians and technologists instead of engineers. It becomes easy for contractors to take advantage of technicians and technologist than engineers. Those who want to be registered as engineers in small municipalities such as Setsoto in the Free State find it difficult because there are no registered engineers to work under them for registration requirement. Worse it is difficult to attract talented people rural municipalities such as Sitsoto Local Municipality (Kahn 2017). Those trying to register as engineers may leave the rural municipality once they are registered as more opportunities may open for them once they are registered.

Ginster et al (2013) observe the existence of skill shortages in small municipalities and the general skill deficit in local government is considered here. There is lack of human capital and skills which is largely caused by the reluctance of skilled people to work in small municipalities. The South African National Treasury (2011) found that the major challenge being faced in the electricity and water services sector is that of skills with the number of engineers per thousand people having fallen dramatically since 1994. Some municipalities simply resort to under-spending because they lack skills. Worse still, a shortage of skills and infrastructure, and an inefficient market limit fiscal policy from reducing unemployment (Nafziger, 2012). It has been

observed that adding 1 job in water and sewer generates 3.68 jobs in the domestic economy to provide for that job (Nafziger, 2012). This underscores the need for the skilling of municipalities, and yet as noted by Krop, Hernick and Frantz (2008) measures seeking to return infrastructure investment differ in nature and remain influenced by historical investments.

There is a link between the scarcity of expertise and skills at municipalities and poor service delivery. Most municipality employees lack skills and this hinders service delivery. Various cases reflect that municipal officials often do not know how to forge strategic associations and involve communities on the widespread spectrum of government-sponsored programmes and tasks in order to improve the life of the poor. A centrally-driven initiative to build capacity in poorly performing municipalities may perpetuate, rather than resolve, the syndrome of dependency on the center. Finally, the skills constraint is further aggravated by the large emigration of skilled professionals (Hogg and Samson 2011).

3.11 PRICING OF WATER SUPPLY

The increasing block tariff (IBT) structure and cost related to pollution are significant in the management and costing of water supply. The National Water Act states that prices must be linked to the amount of water consumed or pollution produced (Meyer, 2007). According to DWA (2013), the costs of untreated water have remained low with the total revenues raised from the trade of untreated water being unable to cover the cost of supplying the raw water. An increasing IBT system has meant greater marginal prices for high-income households (grounded on the statement that rich households generally use more water) (Jansen, 2012). As a result, better water costing is required to show the increasing levels of water scarcity and its worth, force in the direction of high-value consumptions, boost investment and expand water services. Higher-income households are more changeable to price variations; the decrease in water consumption can be realised by growing marginal cost (Jansen, 2012). However, countries, such as Ghana where many families live in multifamily units building equipped with one water meter, face challenges in that poor families are penalised with higher prices (Meyer, 2007).

Subsidisations of electricity and water appears as not implemented properly in most Africa nations (Banerjee, 2008). The absence of access to the water system stops the poorest households from actually being beneficiaries of the cross-subsidisation happening in IBT system (Jansen 2012). In addition, existing tariff structures in various towns are still structured in a way characterised by industrial water consumption carrying the burden of subsidising residential consumption (Whittington and Hanemann, 2006).

The poor are, in some instances, forced to pay more for water supply. According to UNEP (2010), residents staying in the slums of Kenya are charged five to ten times extra for water per unit than those in areas such as London and New York. The charges for water services from official system providers in Uganda, Benin and Kenya were more than $100 in 2006. At the same time, the reality is such that, non-existence of appropriate water and sanitation provision occurring in emerging countries means loss of incomes.

3.12 ACCESS TO WATER SERVICES FOR POOR HOUSEHOLDS

The government has an obligation to provide basic services. As a result, there is need to consider issues related to free basic water, the Indigent Policy Framework and reasons for non-payment of services. Lastly, this section determines the rate of the Sub-Saharan African people's access to water infrastructure.

The South African government is expected to deliver o basic goods and services in accordance with the bill of rights' stipulation that each resident has a right to healthcare, adequate housing, water, food, social education and security (Black *et al*., 2008). As a result, free basic water was introduced to make water economically accessible for all. The free basic water policy stipulates that 6,000 litres, which is equivalent to 25 litres per day, should be provided to everyone for free every month (Jagals, 2012). This constitutes half of World Health Organisation's (WHO) standards which stipulates that a lowest of 50 litres per capita per day is needed to fulfill the requirements for hygiene and consumption. However, according to Gleick (1998) in Echternacht (2014), 45 litres are required per day for drinking, with a further 10 litres for food and 35 litres for sanitation and bathing. Thus, water delivery in regions of the word that do not face water

shortages ought to target the ideal access of 100 liters per capita per day and allow further for all the necessities of citizens to be realised. Nonetheless, the human right to water is limited to the smallest requirement in dry regions of the planet (Echternacht, 2014).

An indigent policy was later introduced by the former Department of Local and Provincial Government. The Framework for the Municipal Indigent Policy states that the delivery of free basic water is foremost aimed at poor households (Jansen, 2012). In addition, it is internationally recognised that the public finances of each country must consider the affordability of infrastructure services *(*Banerjee *et al.*, 2008). Water access and rights for the underprivileged should be secured (Jagals, 2012). However, targeting additional finances to extend the provision of access to those who do not have access can, as noted by Hutton (2012), be a risk the existing served populations who may lose services.

Nonpayment is higher among the poorest. It is an indication that households are facing affordability problems. However, nonpayment is worse for piped water than in electricity (Banerjee *et al*., 2008). Poor people cannot afford even lowest tariffs for cost recovery, which suggests that the poor households should not be forced to participate in cost recovery programs (Hemson, Dube, Mbele, Nnadozie and Ngcobo, 2006). In Greece, it is a common policy for many water utilities to apply low charges for families with four or more children (Tsagarakis, 2005). Similarly, there is an indigent policy in South Africa, which ensures that the poor receive free basic services such as free basic water. Most of the indigent South African residents are poor and unemployed. In addition, poor households cannot afford to buy bottled water or sink boreholes, hence they were the most negatively affected by the crisis in Carolina Mpumalang Province in 2012 (Tempelhoff, Ginster, Motloung, Gouws and Strauss, 2012).

The statistics about access to basic infrastructure in Africa paint a picture of a severely uneven distribution and access to services. The number of households who have both piped water and electricity is only 10 percent in Africa. Only 1 percent of households have piped water, a flush toilet, electricity or a telephone. In addition, most of households in urban areas share water and sanitation facilities as multiple families. More that 50 percent of households in Benin, the Republic of Congo, Burkina Faso, Ghana, Madagascar and Guinea share toilets, while about 50

percent share their source of water in Lesotho (Banerjee *et al.,* 2008). The grim situation in Africa is compounded by the reality that amount of individuals without access to purified water increased by 23 in percentage while the people without sanitation also increased by 30 percent during the 1990-2004 period (Dungumaro, 2009). It should also be noted that only 25 percent of the African population has access to electricity. Nonetheless, there are key differences in electrification between sub-Saharan Africa (23.6 per cent) and North Africa (93.6 per cent) (Butler, Campbell, Mohamed-Katerere, and Mohamed, 2006).

Poor people cannot properly understand the health and time benefit for improved water and sanitation services (Whittington and Hanemann, 2006). Any kind of disruptions water supply will make those who are without water to suffer significantly during the disruptions (Gleick, 2006). The poor are the majority of the population in developing countries and comprise of 82 per cent of world population. Many of the poor people do not have proper housing or adequate food, and are illiterate as well as being in poor health (Nafziger, 2012). The conditions obtaining in South Africa are such that an estimated 5 percent of the total South Africa population still has no water supply services at all. As such, communities collect water from sources such as rivers and streams **(**Jagals, 2012). This reality is also confirmed by (Meeks, 2012), who notes that a lack of water at home compels household members to bring water from other sources such as unprotected rivers, canals and lakes.

Finally, the poor have little economic capacity to establish infrastructure such as tanks, piped water, and flash toilets (Tanyanyiwa and Mutungamiri, 2011). Notwithstanding enhancements in public service delivery for the poor, services do not always reach numerous poorest districts or informal settlements and rural areas. Hence, (Heleba, 2009) observes that 50 percent of all poor households had no piped water in 2005.

3.13 BUDGETS FOR INFRASTRUCTURE SERVICES

The levels of infrastructure spending in Sub-Saharan Africa are varied. Infrastructure expenditure is more than 10 percent of the total spending of households in countries such as Mauritania, South Africa, Mozambique and Gabon. The average is greatest in South Africa, at 23

percent. A number of African households live on very small budgets and spending more than 50 percent of resources on food (Banerjee *et al.*, 2008). A large portion of South Africa resource use is channeled through the political process (Black, Calitz and Steenekamp, 2007). Ideal levels of investment are influenced by the method used to generate extra finance. If more investments in public infrastructure are financed from a rise in taxes, the outcome of those taxes on the economy should be taken into consideration (Krop, Hernick and Frantz, 2008). The Democratic Republic of Congo spends around 18 percent of the GDP on piped water. Nevertheless, a more affluent country like Gabon spends 0.02 percent of the GDP. In addition, total levels of infrastructure expenditure by rural households are not that diverse from urban households, with rural household expenditure standing lower and yet in terms of budget shares the expenditure is higher (Banerjee *et al*., 2008).

Local government collects about 90 percent of their own aggregate budget as own revenues in South Africa. The national government transfer to local government is smaller than that to the provincial level (Black et al 2008). However, small municipalities rely on national transfers. National Treasury (2011) recommends that the budget for local government will have to grow because there numerous smaller municipalities have inadequate water and sanitation infrastructure.

3.14 THE EFFECT ON WATER SUPPLY AND SANITATION ON GROWTH

This subsection examines the economic impact lack of water and sanitation. It also highlights the benefits of investment in water and sanitation.

There is less known about the economic consequence of poor sanitation even though the health consequence is known (Van Minh and Hung, 2011). Poor water and sanitation pose serious macroeconomic risks for travel, tourism, trade and investment (Whittington and Hanemann, 2006). Tempelhoff, Ginster, Motloung, Gouws and Strauss (2012) found that businesses such as guest houses lost clients and some declined to check in after the news about the water contamination at guest houses in Carolina Mpumalanga. Some business resorted to sinking own boreholes.

According to literature, investment in water and sanitation has positive impact on economic development. Hutton (2012) revealed that economic benefits are at least worth double the investment in water services delivery and at least at five times the investment for sanitation services.

3.15 WATER LOSS FROM LEAKAGES AND THEFT

The focus is here is on the way water and sanitation is affected by the stealing of water taps and pipes, water loss and water interruptions. Consider also are the municipalities' poor maintenance practices and their contribution to water losses and protests and vandalisms by residents.

People normally steal taps and piping from communal facilities so that they can do their own upgrading to yard connections (Hemson, Dube, Mbele, Nnadozie and Ngcobo, 2006). The theft of cables and equipment contributes to water loss and supply interruptions. Theft of machinery or cables is a serious problem for water supply in Brandfort, for example, as a result, copper pipes are being exchanged for aluminum ones which are less attractive to thieves (Ginster *et al.,* 2013).

Nonetheless, municipalities play a role in the existence of water losses due to poor maintenance of infrastructure within their water connections and an inappropriate management of assets (Ginster *et al.,* 2013). According to the DWA (2013), insufficient repairs and maintenance cause undesirable water losses. In certain situations, water loss exceeds 60% of the available water, while various treatment works are in poor condition and many are unable to maintain wastewater quality standards. In the Gauteng province of South Africa, more than half of the water supply was lost because of leakages, inefficiency and illegal connections.

Vandalism occurs because of the aggression and disappointments amongst those who are under the impression that water would have been interrupted under less reasonable grounds. The other reason is that water is frequently interrupted for nonpayment as some people are not able to pay for yard connections (Hemson *et al.,* 2006). As a result, protests normally occur in the urban

areas of South Africa. Violent protests normally occur in low and middle income residential urban areas. But current substantiation reveals a rise in rural demonstrations (Tapela, 2013).

3.16 POPULATION GROWTH

Population growth and urbanisation affect the demand for water services. The rapid increase in the urban population makes it difficult for government to provide basic services. Boreholes, hand pumps and tap water are the basic sources of water on which people commonly depend on (Jabeen, Mahmood, Tariq, Nawab and Elahi, 2011). The rising demand for water arises from variations in the population and from changing of migration and urbanization (Jansen, 2012). The demand for water also increased in South Africa owing to the post-1994 government policy to eradicate the bucket system and introduce waterborne (flush) systems (Ginster *et al*., 2013).

High population growths have been experiences in countries such as China, Indonesia and India, while the Sub-Saharan countries have experiences moderately small population increases due to the prevalence of poverty (Nafziger, 2012). Nonetheless, Africa faces a population growth, quick growth of peri-urban areas and economic development in a context that is mostly characterised by the nonexistence of sustainable water management (Corcoran, Nellemann, Baker, Bos, Osborn, and Savelli, 2010).

Urban populations in Africa are increasing at 3.6 percent annually with the following highest annual population growth rate of 3.1 percent found in East Asia. Africa is however, lagging behind other emerging regions with regard to access to infrastructure *(*Banerjee *et al*., 2008). It is projected that that between 2015 and 2020 the number of urban people in emerging countries will surpass the number of rural people for the first time. Larger cities will demand even extra water as the people's life styles changes (Sanctuary *et al.*, 2004).

3.17 ACCESS TO WATER AND SANITATION IN DIFFERENT COUNTRIES

This part of the chapter considers the contradiction witnessed in proportions of income and infrastructure access is some parts of Africa, the demand and supply side barriers and the

distances that people have to travel in Africa to collect water. Also evaluated here is the people's use of boreholes and interaction with surface water and the details on the water usage by households in Africa**.**

Many rich households in some parts of Africa do not have access to the complete set of contemporary infrastructure services. Countries such as Uganda, Tanzania and Nigeria have a fairly high income but low amount of infrastructure, while nations such as Zimbabwe and Zambia have a comparatively low income but comparatively high aggregate infrastructure (Banerjee *et al.,* 2008). In addition, more than half of rural households in Tanzania live more than two kilometers from a water source. Nonetheless, Nigeria, South Africa and Madagascar have less than 2 percent of rural households that live more than two kilometers away from a water source. Every household in Sierra Leone does not have water inside dwelling (Sanctuary *et al.,* 2004). Another significant reality is that 92 percent of the residents in African cities have various forms of sanitation, however basic. Yet, more than 80 percent of the rural residents, as noted in Burkina Faso, Benin, Chad, Togo and Niger, lack access to sanitation (Banerjee *et al.,* 2008). Finally, those who do not have access to water are divided into those close to infrastructure but nonetheless facing demand-side barrier and those who are far and face supply-side barriers (Banerjee *et al.,* 2008).

According to the National Water Resource Strategy (2013), South Africa has less levels of rainfall comparative to the world. In addition the rainfall is variable and there are high levels of water pollution. The country's limited running water capacity is also noted in the comparison where observations show that a River like the Congo carries greater than a hundred times more water than the Orange River, the biggest river in South Africa. The limited rainfall and water sources availability can be attributed to the effect of climate deteriorations. Climatologists found that a reduction in the forestation of the Southern Cameroons and Southern Nigeria tropical rain forest reduced the levels of rain in the Sahel, Niger and Chad (Nafziger, 2012). According to NWRS (2013), greater than 60 percent of the river flows comes from merely 20 percent of the land as poor land-use practices are causing the sedimentation of river channels, reservoirs and lakes and variations in hydrology.

Different countries use different water sources with boreholes being used the most in Africa. The use of boreholes is noticed more in the rural areas (Banerjee *et al.*, 2003). As a result, the NWRS (2013) acknowledges that groundwater is important and in some parts of South Africa it is the only source water. This ground water is in most cases inadequate and frequently of poor quality (Meyer, 2007). In addition, the interaction between ground water and surface water is not adequately quantified (NWRS 2013; Meyer, 2007). This has, however, not stopped artificial recharge, which involves storing water underground for later abstraction and use, which is becoming popular in South Africa and internationally.

The global average water-use statistics are quite varied and depend with place under focus. Thus, African households use an average 47 liters of water per individual. The average household water use in Asia is 95 liters. Finally, the average household water use in United Kingdom is 334 liters per individual per day and in USA, the normal use is 578 liters per person per day (Rathgeber, 2003).

3.18 INEQUALITY

The subsection compares the levels of inequality between South Africa and other countries. It also considers the fertility rate in an equal society.

South Africa is one of the nations that have the highest levels of inequality on the planet earth. However, the levels of world inequality exceed that of any particular nation. The top 20 percent of the world's income-receiving households obtain 72.4 percent of the world's income and the lowest 40 percent obtain only 5.7 percent. In South Africa, the highest 20 percent high income earners get 66.5 percent of the earnings while the bottom 40 percent receives 6.3 percent. Most countries show deteriorating inequality and yet the world displays dropping inequality. The world's inequality fell as result of the growth of the middle class in China, India and other Asian countries (Nafziger, 2012). Nonetheless, urban inequalities have grown in the global south, particularly in countries that include India, South Africa and Brazil, where most residents live in precarious urban settlements (Carolini, 2012). Social Economists argues that great inequality is unavoidable in a capitalist culture. However, in diverse or capitalist LDC, such as South Korea,

Japan and Taiwan, poverty and income inequality have been substantially reduced (Nafziger, 2012).

Fertility tends to be lower when income distribution is more even. People turn to have a less number of children when they have better economic security and high income (Nafziger, 2012). Increasing earnings are linked with piped water and a declining dependency on wells and boreholes, (Banerjee *et al*., 2008).

3.19 FEMALE HEADED HOUSEHOLDS

Female headed households are affected by water availability and access issues with some spending a lot of time collecting water.

The amount of female-headed households remained sizable, fluctuating between 13 percent in the Near East/North Africa and 16 percent in Asia. The amount of female headed households is 22 and 24 percent in Sub-Saharan Africa and Latin America respectively (Dungumaro 2009). An average African household uses about 45 to 50 minutes per day bringing water from sources that are far from the household. The time used to collect water has not changed in the previous 15 years (Banerjee *et al.*, 2008). The water crises in Malawi disrupted women and girls activities (Chipeta 2009). At the same time, females and children lose valuable time with their husbands and fathers while collecting water (Machete, 2011). Girls who collect water from long distances turn to be absent more in schools. Women have been observed as having a lesser amount of education than men in numerous emerging countries largely due to responsibilities in their families (Dungumaro, 2009).In addition women are more vulnerable to climate-related consequences than men and male-headed households (Mason, 2012). However, households with female bread winners seem to priorities sanitation facilities than those with male breadwinners (Harapap and Hartono, 2007).

3.20 VARIATIONS BETWEEN RURAL AND URBAN ACCESS IN DIFFERENT COUNTRIES

The access rate to water infrastructure in urbanised countries, reduction in rural and urban access in South Africa and the monitoring systems for municipalities are the focus of attention in this section.

The residents of urbanised countries and even those who stay in rural areas have better access to infrastructure (Banerjee *et al*., 2008). The difference between rural and urban access in South Africa has been reduced in the past two decades (Marshall, 2011). The changes that are faced by rural municipalities are different to those faced urban municipalities. Nevertheless, the systems to monitor municipalities are not different for urban and rural municipalities (Rivett, Champanis and Wilson-Jones, 2013).

In African countries such as Mauritania, even people who stay in urban areas have to collect water far away. For instance, 66 percent of households in Mauritania stay further than two kilometers from the water source. Nonetheless, fewer than 5 percent of households in urban areas in the Democratic Republic of Congo, Republic of Congo, Ethiopia, Niger, Morocco, Nigeria, South Africa, Zambia and Uganda, have households stay two kilometres away from a water source (Banerjee *et al.,* 2008). South Africa and Botswana have the highest proportion of households staying in urban areas that use more water (Lange and Hassan, 2006). Generally, urban residents have better services than rural residents. However, unsafe water, dry taps and the lack of sanitary toilets or sometimes no toilets at all, are experienced by people daily in the rural areas (Muller *et al.,* 2009). About 80 percent of people who stays in cities in Zimbabwe and South Africa have the modern sewage infrastructure systems to meet the needs. In Namibia, Windhoek's 96 percent of households have piped water, while 97 percent have access to the sewerage system and 88 percent have access to electricity ***(***Banerjee *et al.,* 2008).

3.21 ACCESS TO SANITATION

There is need to examine how some people Africa dispose their own waste and the state of pit toilet use on the continent. Firstly, more than 50 percent of African households take care of their own household waste by dumping, burning or burying it. More than 90 percent of households in Rwanda, Ghana, Sierra Leone and Madagascar dump their own garbage (Banerjee *et al.,* 2008). There are no collection methods in rural areas in Rwanda, Congo and Ghana as a result; everyone dumps their household waste (Banerjee *et al.,* 2008). At another level, global cities such as Singapore, Mumbai, and Boston have extended landfills. However, only 11 percent of the land is cultivated with new arable land being constantly produced through the use of fertilizer, new seeds, new machinery, irrigation and drainage (Nafziger, 2012).

The most used system of sanitation in Africa is the old-style pit latrine. It is used by 51 percent of the citizens. In Tanzania, Uganda and Malawi, three out four people use the old-style pit latrines. As a result, the population is constantly exposed to the cholera bacteria after flooded latrines contaminate water sources. In addition, improper sanitation contaminates ground water, as evidenced by the cholera outbreaks that were witnessed in Côte d'Ivoire and Tanzania owing to inadequate sanitation (Butler *et al.,* 2006).

3.22 WATER QUALITY

The quality of water is very important and its contamination has a huge impact on health and education in South Africa and the world over. As a result, there is need consider issues pertaining to water quality and how they relate with the treatment of waste water and the larger health and other issues.

The National Water Resource Strategy (NWRS) (2013), states that the quality of water is being made worse by effluent discharges from mining and other developmental activities. Natural resources cannot be produced unlike capital which can be produced (Nafziger, 2012). For instance, the disruptions witnessed in Carolina (South Africa's Mpumalanga Province) were the result of the deterioration of tap water into an undrinkable state. The Carolina water was

contaminated by mine drainage (Tempelhoff *et al*., 2012). According to the NWRS (2013), mining, urban development, industries and agriculture are the main contributors to water quality problems. Untreated or inadequately treated wastewater affects the quality of water in numerous ways and different places in the country. Acid mine drainage (AMD) was reported in areas that include the Witwatersrand Gold Fields, KwaZulu-Natal and Mpumalanga Coal Fields and the O'Kiep Copper Region in South Africa. The reality is such that, water and land in Africa are contaminated through people's poor sanitation and discharge of industrial effluent, as well as the release of untreated sewage, disposal of solid wastes, discharge of food-processing waste and release of liquid from refuse dumps. These activities that negatively affect the quality and quantity of water resources lead to rises in the cost of water.

The threat and results thereof to water quality in sub- Saharan Africa (Butler et al., 2006) has had and continue to impact on the people's health. Water quality is a big challenge in most countries (DWA 2013). For instance, there were cholera outbreaks in Kenya after the wells, most of which were constructed near latrines, had their dirt leak into wells (Marshall, 2011). This shows that contamination deteriorates the quality of water and causes detrimental environmental and health problems. In addition, and closer to the area under study, the South African public's perception on water quality is negative and this has a negative impact on the economy (Van der Merwe-Botha, 2009).

Furthermore, other countries, such as China, face serious water challenges. China indeed faces a huge water scarcity. The country also suffers from the effects of water pollution such that the Chinese industries' loss of earnings on account of water pollution in 1992 was estimated at $1.7 billion (Sanctuary *et al*., 2004). Outputs and consumption make emissions into water, thus leading to the kind of gross pollution witnessed in China. It should, be noted that this state of pollution is also witnessed in and arises from the more than 90 percent of less developed countries that discharge their urban sewage without adequate treatment. Yet, the impact of pollution depends on the foundation of growth of a particular country, as pollution increases if growth is achieved through a capital intensive source (Nafziger, 2012).

Finally, an improvement of water quality impacts positively on school attendance and the cognitive function of children (Kayser, Moriarty, Fonseca and Bartram, 2013). People's health can be improved through a better and safe disposal of human excreta. An improvement of the quality and quantity of drinking water, through the delivery of sanitation services, also improves the people's health (Jabeen *et al.,* 2011). However, the reality is that water quality is worsening; municipalities are falling to maintain ageing water and waste water infrastructure on account of lack of personnel with skills (Ginster *et al.,* 2013).

3.23 CLIMATE CHANGE

This section examines the effects of climate change and their impact on the poor and climate change's influence the water intake rate in different areas of South Africa have.

According to the NWRS (2013), climate change in South Africa will reduce the quantity of water, even if the impacts will be disproportionately distributed and with the eastern coastal areas of South Africa becoming wetter. Climate variation is expected to be the principal cause of droughts in the inland and western regions of the country. Furthermore, most cities in South Africa are located in areas far away from big rivers and as such their water requirements exceed the natural availability of water (Meyer, 2007).

Climate change will intensify heat waves, drought, and tropical storms. It will lead to the rise of sea level, change vegetation zones and negatively affect grain and other crop production (Nafziger, 2012). The problems affecting water resources in South Africa include drought, floods, pollution and dirty water. Poor waste water treatment works lead to the deterioration of water quality, as witnessed in the Hartebeespoort Dam in the North West Province (Van der Merwe-Botha, 2009). Shocks such as floods and droughts have adverse consequence on the growth prospects particularly agricultural in the agricultural community (Sanctuary *et al.,* 2004) Drought also affects the economy and people's livelihoods (Marshall, 2011). Fisheries from lakes, rivers and other water ecosystems are a vital source of nutrition and income in Africa, Asia and Latin America. Poor households are extra vulnerable to losses in fisheries and dreadful

conditions of wetland resources. They lack capacity to cope with shocks such as drought, health problems as well as livestock death (Sanctuary *et al.*, 2004).

Climatic conditions can change demand for water. Rise temperatures may make people to drink more water (Jansen, 2012). At current usage and price level, water is not sufficient to meet the demand for the next 30 years (Meyer, 2007). The growth of industrialisation in the developing countries raised the energy demands, food production, and climate change and population growth. As a result, 50 percent of the world population will be living with long-lasting water stress by 2025 (Van der Merwe-Botha, 2009).

3.24 WATER DEMAND AND CONSERVATION

This part of the chapter issues on water demand in relation to supply, water conservation and water demand strategy.

Water is scarce particularly in arid and tropical areas but the demand for domestic connections continues to rise in urban areas (Tanyanyiwa and Mutungamiri, 2011). There are various technical problems, such as blown non-return valves and main pipeline bursts, whose occurrences would be an indication that the demand for water exceeded the available supply (Ginster *et al.*, 2013). Nonetheless, development and allocation procedures are important in arid provinces. As a result, South Africa is shifting from demand to demand management and water pricing in management in a sustainable and equitable way. Water demand management involves the application of a strategy that impacts the demand of water to meet economic efficiency, social development, sustainability of water supply, social equity, political acceptability and environmental protection (Meyer, 2007). An example of successful strategy was the introduction of behavioral messages in Cape Town that influenced communities to reduce the consumption of water by between 0.6 percent and 1.3 percent. The first behavioral messages to households were about addressing households with regard to information failure around price and the consumption of water. Second messages encouraged water conservation through social inducements and appeals to the public good (Brick, De Martino and Visser, 2017).

According to Sanctuary et al., (2004), water conservation and water demand management may postpone the requirement to invest in new investment in infrastructure. In Gauteng Province of South Africa, growth in demand must be met with $1.5 billion investments on waste water management plants and a $2.7 billion investment on water expansion schemes. The possible benefit for delaying a development is 7 percent of the cost of infrastructure. In addition, [Technical problems include a breakdown at the water works, cable theft, blown non-return valves, main pipeline burst are an indication that the demand for water exceeded the available supply (Ginster *et al.*, 2013).] According to the NWRS (2013), many water management areas (WMA) require water (i.e. the water requirements are more that accessibility of present infrastructure in spite of substantial transfers from other sources). Yet a few WMAs have more than enough water in South Africa, hence predictions that WMAs would have water shortfalls by 2025.

3.25 AGRICULTURE

The South African agricultural sector uses huge volumes of water, as a result there is need to evaluate this sector's water use in relation to water scarcity and how it compares with the crop land of Sub-Saharan Africa and Asia.

According to the NWRS (2013), irrigated agriculture is the largest user of water in South Africa. The agricultural sector accounts for about 60% of water use in South Africa. But it supports the South African economy and contributes largely to rural development. It assures food security and creates employment during the course of food production. There are plans to increase irrigated land in South Africa with the DWA promising to allocate an equal volume of water. An increase in irrigation will be influenced by selected new development and water-use efficiency. According to the SIWI (2004), a move away from using water-intensive agriculture and industries reduces water scarcity. Most of the time, the marginal cost of irrigated water is very low while that of monitoring water use is more, making water task public goods and proving a reason government provision (Nafziger, 2012). However, an increase in agricultural production and the inelastic demand are expected to decrease agricultural terms of trade and lead to a further decrease in rural income as well as a rise in the urban-rural inequalities. Irrigation has the

capacity to increase agricultural productivity. The comparison on irrigated agriculture between Africa and other continents shows a big disparity where in Asia, 35 percent of the cropland is irrigated while a mere 5 percent of cropland is irrigated land in sub-Saharan Africa. The indication, therefore, is that small farmers are struggling to get access to water (Nafziger, 2012).

3.26 WATER SCARCITY

There is a crisis of water shortages the world over, as clearly stated in the case of the Middle East and North Africa (MENA) region, cited here. This scarcity and issues such as inefficiency, wastage and the location of industries and mines in water scarce part of South Africa are reviewed here.

The MENA region is facing water scarcity more than other regions of the world. The MENA region offers 1 200m^3 water availability per capita per person per year while the world's average is 7 000m^3 per person per year (Meyer, 2007). Water scarcity exists in some countries, such as South Africa, but the situation gets worsened by management and operational errors and inefficiencies. This observation is confirmed by the NWRS (2013) in their assertion that, although South Africa is a water scarce country, there are high levels of inefficient use and wastage of water. In addition, some new mines have been established in water scarce areas, such as the Limpopo Province, which puts an even extra burden on water resources. Mines also pose a water pollution threat. In the meanwhile, South Africa is dependent more on surface water and its development, a condition that is inadequate for the economy. Hence, South Africa, just as some of the countries from the MENA region but at a comparably lesser level, is facing challenges with regard to security of supply, with its situation made worse by resource pollution and environmental degradation.

According to the NWRS (2013) water supply shortfalls are normally caused by poor water supply management. Water management problems include lack of metering, enormous wastage of water, high per capita use, and free water actuality delivered even to the rich, lack of proper maintenance, poor cost recovery, lack of skilled operators and a low technical competency. According to Butler et al (2006), water shortage is not wholly natural as it is also caused by the

low levels of investment in water and lack of capacity to manage the growing demand for water necessitated by a population increase and economic growth. Ultimately any failure to mitigate water scarcity has consequences such as limiting the use of other factors of production such as labour, capital and entrepreneurship (Meyer, 2007).

Water use has grown despite improvement in efficiency (Lange and Hassan, 2006) and this impact on demand and supply issues. It has been observed that water will become scarcer as more cities demand clean water (Meyer, 2007). According to the NWRS (2013), water resources are disproportionate to the amount of available land. For instance, areas which make up 8 percent of the land area across Swaziland, South Africa and Lesotho provide 50 percent of the water in these countries. In addition, more than 60 percent of the river flows come from only 20 percent of the surface area. This underscores that South Africa is likely to face the harsher effects of water scarcity unless there is an improvement in water management, conservation and supply through the construction of more and efficient water supply projects (NWRS 2013).

3.27 PUBLIC AWARENESS CAMPAIGNS

Public awareness campaigns, which are often lacking in South Africa, should be prioritised as the absence thereof is linked protest actions. This unwillingness on the part of the authorities to share information indeed contributes to protests action in South Africa (Ginster *et al.*, 2013). Households sometimes do not know the programmes that are accessible from government, while local, provincial and national government do not at all times predict properly what is required (Heleba, 2009). In addition, lack of awareness is one the reasons behind numerous diseases amongst the people (Jabeen, Mahmood, Tariq, Nawab, Elahi (2011). The Department of Water Affairs is implementing the national water education and public awareness programmes through the 2020 Vision Curriculum Support Programme, Baswa Le Metse, Aqua Enduro and Public Speaking to increase awareness on water and sanitation and other delivery issues. An increase in the level of education leads to increase in willingness to pay (Khan, Iqbal, Saeed and Khan, 2010).

3.28 THE BENEFITS OF IMPROVED ACCESS TO WATER AND SANITATION

According to the SIWI (2004), financing the health of the environment, people and extra efficient water usage protects future economic gains. Reductions in mortality and time saved from improved water and sanitation accounts for a large share of the total benefits (Hutton, 2012).

Improved access to water and sanitation make significant social and economic gains. People who are healthy have a pattern of studying more. This means that the more educated people are the healthier they are likely to be. Improved access to infrastructural facilities enables labour to do carry out tasks without difficulty and perform them rapidly (Dissou and Didic, 2013). According to Sanctuary *et al.,* (2004), the benefits involve less health facility consumption for both the health sector and the patient. The fall in the number of days that a person is ill can induce benefits like more school attendance, while less time spent fetching water enables children to have more time to focus on learning.

Better water and sanitation infrastructure and access reduces the rate of disease transmission. About 64 000 people per year die from water-related infection. High prolusion lead to IQ loss on affected children of about 6.5 on the IQ scale (Sanctuary *et al.,* 2004). According Hutton (2012) ,poor water leads to high infant mortality and high infant mortality makes parent to make more babies. A big number of children then reduce the capacity of poor parents to finance the health and education for the children. Numerous infections affecting residents in Africa, Latin America and Asia are associated with the environment (Dungumaro, 2009). Child mortality fell by 8 percent where the provision water was privatized. Majority of water related infections are contagious. There is a link between privatization and a fall in infectious and parasitic diseases which are related to water(Galiani , Gertler and Schargrodsky, 2003). Van Minh and Hung (2011) point out that about 80 percent of the cases of diarrhea diseases are associated with poor sanitation and hygiene. These adverse effects can indeed be reduced, as noted in the way water, hygiene and sanitation-related diseases were significantly decreased in the USA and Central Europe after the implementation of protective measures on water sources and the setting up of sewage system in the 20th century (Jabeen *et al.,* 2011).

The cost and benefit water investments analyses on a global scale have frequently concluded that the benefits outweigh the costs regardless of which scenario is considered (Hutton 2012). Hutton (2012) further notes that the benefits depend on the infrastructure that is in place, with a large stock of infrastructure leading to a high quality. However, there are more benefits from improved sanitation than those related to improved water access. Improving sanitation contributes towards attaining gender equity and it supports the safety of the environment, bolters education and provides for economic growth (Van Minh and Hung, 2011). Hence, an improvement in investment in water supply and sanitation services provides both immediate benefits and long term health and economic benefits (Sanctuary *et al.,* 2004).

The return of water and sanitation depends on the region and the technological choice with a range between $3 and $34 for every $1 invested. Considering ecosystem has led to a move towards fisheries and its role to poverty alleviation. Maintaining fish contributes positively to food security. The yearly per capita cost to achieve the MDG with regard to water and sanitation services in Cambodia, Bangladesh, Tanzania, Ghana, and Ugandia varies from about $ 4 to $ 7 per capita yearly. The cots and returns depend on the region and the technological choice with a range falling between $3 and $34 for every $1 invested. The yearly per capita cost to achieve the MDG with regard to water and sanitation services in Cambodia, Bangladesh, Tanzania, Ghana, and Uganda varies from about $ 4 to $ 7 per capita yearly (Sanctuary *et al.*, 2004).

3.30 CONCLUSION

South Africa has achieved the MDG target with regard to the provision of water. However, the percentage of access for the Limpopo and Eastern Cape Provinces are below the target (Millennium Development Goals, Country Report 2013). Despite meeting targets of the MDG, there are still people in rural areas who do not have access to basic water services (Heleba, 2009). South Africa introduced free basic water to ensure that the poor have access to water services (Jagals, 2012). An estimated 5 percent of the total South Africa population still has no water supply services at all and such communities collect water from sources such as rivers and streams **(**Jagals, 2012).

Few households, even among the rich, have access to modern infrastructure services in some countries in Africa. More than 90 percent of the families in some countries in Africa take care of their household waste. In addition, some countries' total rural households do not have access to waste collection facilities. The infrastructure in some parts of Africa is disproportional to income where countries with lower income have better infrastructure than those with high income (Banerjee *et al.,* 2008).

There are many people in urban areas who have not attended any formal education or training. Such people lack awareness on the causes and solutions to their environmental problems (Tanyanyiwa and Mutungamiri, 2011). However, studies in Ghana show that villagers demonstrated good understanding of hygiene habits after training on hygiene habits, even though most did not implement the knowledge afterwards (Balint, 1999). The suggestion therefore, seems to be that poor people do not full appreciate the health and time benefit of improved water and sanitation services (Whittington and Hanemann, 2006).

The benefit for investment in water exceeds the cost (Sanctuary *et al.,* 2004). There is a lot of poor maintenance in water infrastructure and this has led to unreliable pipes and water supply interruptions (Heleba, 2009). According to the DWA (2013), poor repairs and maintenance has resulted in undesirable water losses in South Africa, sometimes 60% of water is lost. A number of treatment works are functioning well but lack capacity to meet the required wastewater quality standards.

Sub-Saharan Africa is far behind when it comes to water storage capacity. Countries from the region require massive investments in order for them to attain the levels of infrastructure equivalent to that of South Africa, even though South Africa has a way less storage capacity when compared to countries such as Brazil and China (Sanctuary *et al.,* 2004). An improved water and sanitation investment contributes positively to economic growth (Sanctuary *et al.,* 2004). Any infrastructural deterioration, as noted in the fall of the tourism and accommodation business in Corolina, Mpumalanga after a water contamination case (Tempelhoff et al., 2012), reduces economic growth.

Water scarify can be minimised by shifting away from water intensive agricultural products. However, water scarcity is not only natural it also depends on how water is managed (Butter et al., 2006). The fact that service providers are judged on output rather than the impact, it limits the accountability of providers towards the beneficiaries (Hogg and Samson, 2011).

Nonpayment is higher among the poor because affordability problems. However, nonpayment is more on piped water than on electricity (Banerjee *et al*., 2008). Higher-income households are more elastic to cost changes; a decrease in water consumption is attained with a rise in marginal prices in terms of increasing block tariff structure (Jansen, 2012). Nonetheless, countries such as Ghana have many families live in multifamily units building equipped with one water meter. This has led to poor families penalized with higher prices (Meyer, 2007). According to UNEP (2010), people living in small rural areas in Kenya pay five to ten times more for water per unit than those in high-income areas, like London and New York.

Poor service provision is linked to shortage of expertise and skills in municipalities. Some officials do not understand strategic issues and to involve communities on the wide range of government programmes and tasks. The existence of three spheres of government seems to prevent a dynamic use of scarce skills across the spheres (Hogg and Samson, 2011). The water quality is deteriorating, municipalities are not capable to maintain old water and waste water infrastructure for the reason that nonexistence of persons with skills (Ginster *et al.*, 2013).

South Africa is better in terms of collective action between the public and the private sector. However, there is still a need of building trust between the two sectors (Naidoo, 2017).

CHAPTER 4

4.1 INTRODUCTION

This chapter discusses the research methodology used to investigate the factors that hinder service delivery in the Free State. It also describes the binary dependent variables and explanatory variables that were collected from the archive and data on the Free State's towns. Furthermore, the chapter explains the relationship between the dependent and independent variables used in the logistic regression model. In addition, it outlines the model selection tests involving Wald and Z tests and the diagnostic tests such as Holmer-Lemeshow and McFadden R^2 that are used to assess the goodness of fit. Finally, the Chapter explains how questionnaire data was collected.

4.2 DEMOGRAPHIC STRUCTURE OF THE STUDY AREA

The Free State Province is divided into five District Municipalities, Xhariep, Lejweleputswa, Thabo Mofutsanyane, Fezile and Mangaung, as shown the map below. The province has 19 Local Municipalities and one Metropolitan Municipality. All the 19 Local Municipalities and a Metropolitan Municipality are authorised to ensure the provision of water services.

District Map for the Free State

Surface water resources are well developed through the construction of several large dams, with future water requirements depending on increased water transfers. In addition, the Free State's groundwater is currently used in areas where surface water supply is inadequate or bulk water supply is not financially feasible. However, most of the province's towns rely on surface water to supply water in the communities. Other towns, such as Alington, Boshof and Dealsville, depend on solely on boreholes to supply water to communities, while some, such as Trompsburg, Rouxville, Smithfield, Rastron and Paul Roux, using a combination of surface water and boreholes.

According to the DWS archived information, municipalities in the Free State source surface water from the Upper Vaal, Middle Vaal, and Lower Vaal and Upper Orange catchment. Most municipalities source water from a single catchment Municipalities. Only six municipalities share a catchment. Ngwathe Local Municipality (LM) and Dihlabeng LM both share the Upper Vaal and Middle Vaal catchment, while Setsoto, Mantsopa and Masilonyana LM all share the Middle Vaal and Upper Orange. In addition, Tswelopele LM gets water from the Middle Vaal and Lower Vaal. Finally, Tokologo LM and Tswelopele LM are the only two municipalities in the Free State Province that are sourcing water from the Lower Vaal Catchment.

According to the Free State's Provincial Spatial Development Framework (PSDF), agriculture uses 90 per cent of land-use, with 7 per cent of the land used for settlements and 1.6 per cent of the land set aside for conservation. Mining occupies 0.4 per cent of the land.

4.3 DATA COLLECTION FOR THE STUDY

The study uses a mixed methods approach in order to get a full picture of the issues surrounding poor service delivery of water. Quantitative data from secondary sources located in the electronic databases and the archival records on the various municipalities was collected. The collected data was particularly on maintenance, low income households, female headed households, total number of households, water storage capacity, grant disbursement per town, ageing infrastructure, water demand, water loss and the amount of water in dams. The Researcher

collected archived data from towns in the Free State, where 20 municipalities manage about 83 towns, in order to run the logistic regression analysis.

The study also employed a survey questionnaire on water supply disruption as a function of factors that cause water supply disruptions. Qualitative and quantitative data was collected through the use of a questionnaire. The questionnaire comprises both closed and open ended questions. It was administered to a minimum of 3 key informants (high ranking administrators, water engineers and other senior technicians) from the 19 municipalities and one metropolitan municipality, for convenience we will term them 20 municipalities.

4.4 PROBLEM STATEMENT

Many towns and cities still have unreliable piped water systems and experience supply interruptions, high leakage rates and unaccounted water. A number of water supply interruptions have indeed occurred in the Free State Local Municipalities. Water Services Authorities are also not doing enough operation and maintenance of infrastructure in the Free State, just as Water Losses are very high and the exact amount of water losses is unknown (Ginster et al., 2013).

There are no studies that focused on the entire Free State Province with regard to disruptions of water supply. Most studies focus on specific towns where there are relatively frequent water supply crises. This study aims to fill that gap.

4.5 AIMS AND OBJECTIVES

The study aims to identify the factors that are associated disruptions of water supply in the Free State Province.

The first objective of this study is to identify factors affecting water supply to Free State households using archival data. Emanating from this first objective are the following sub-objectives

- To assess whether poor maintenance is associated with frequent disruption in water service delivery.
- To assess whether Water Storage Capacity is linked to the frequency of disruption in water supply.
- To establish whether the amount of grant disbursements per town have a correlation on whether there is frequent water disruption or not.
- To investigate whether the number of poor households does not have a connection on whether there is frequent water disruptions or not.
- To establish whether the number of households in a municipality is linked to frequency of water disruptions or not.
- To determine whether ageing infrastructure is linked to frequent disruptions in water service delivery.
- To assess whether infrastructure backlogs can be associated with frequent disruptions in water service delivery.
- To investigate if the quantity of water demanded is associated with frequency of water disruptions or not.
- To find out whether the amount of water demanded in litres per capita per day is linked to frequency of disruptions.
- Establish whether the amount of households having piped water inside a dwelling is associated of frequency of supply disruptions.
- To assess whether the number of female headed households in a town is linked to the frequency of water supply disruptions
- To investigate whether the quality of discharged effluent can serve as a predictor of water supply disruptions.
- To establish whether water level in dams can be linked the frequency water supply disruptions.
- To determine if the amount of water loss in a municipality is associated with the frequency of water supply disruptions.
- To investigate whether low income households as a percentage population in a municipality can serve as a predictor of the frequency of water supply disruptions.

- To assess whether the high density of informal households on RDP level in a municipality is a suitable predictor of the frequency of water supply disruptions.
- To ascertain if the total number of households below the RDP level on sanitation can be associated with frequent water disruptions.

The second objective of this study is to access the perceptions of Water and Sanitation division municipal officials in regard to causes of water supply disruptions to Free State Households. The following are the sub-objectives stemming from the second objective:

- To assess the perceptions of municipal officials with regard to ageing infrastructure, water storage capacity, water quality (colour, smell and taste), poor effluent discharged in water resources, lack of water treating technologies, water loss , amount of water used by commercial farmers, institutional arrangement, strikes, debts from consumers, revenue raising capacity, number of poor households, metering, non-payment for water services, low equitable share grant and conditional grants, tariffs not reflecting cost, water demand, town development, droughts, electricity disruption and skill shortage cause frequent disruption in municipalities.
- To determine the perceptions on whether ground water , surface water and average rain fall is a problem in municipalities that leads to disruption in water supply
- To determine perceptions with regard to concerns on different infrastructure in municipalities
- To investigate perceptions regarding skill shortages for Engineers, Process Controllers and Leadership's impact on the frequency of disruption.
- To assess perception on whether poor areas are experience more frequent disruptions than their rich counterpart.

4.6 RESEARCH HYPOTHESES RELATING TO MAIN OBJECTIVES

A research hypothesis makes a prediction. The hypothesis being tested is referred to as the null hypothesis and it is denoted $H_{0,}$ it is also referred as the hypothesis of no difference and includes a statement of correspondence. There is also an alternative hypothesis, which presents the alternative to the null hypothesis and comprises of a statement of difference.

The following are the research's hypotheses and are related to the first objective:

Hypothesis 1

H0: Poor maintenance is not associated with frequent disruption in water service delivery.
H1: Poor maintenance is associated frequent disruption in water service delivery.

Hypothesis 2

H0: Water Storage Capacity is not linked to the frequency of disruption in water supply.
H1: Water Storage Capacity is linked to the frequency of disruption in water supply.

Hypothesis 3

H0: The amount of grant disbursement per town is not linked to whether there is frequent water disruption or not.
H1: The amount of grant disbursement per town is linked on whether there is frequent water disruption or not.

Hypothesis 4

H0: The number of poor households is not associated to whether there is frequent water disruptions or not.
H1: The number of poor households has is associated to whether there is frequent water disruptions or not.

Hypothesis 5

H0: The number of households is not correlated to whether there is frequent water disruptions or not.
H1: The number of households is correlated to whether there is frequent water disruptions or not.

Hypothesis 6

H0: Ageing infrastructure is not correlated with frequent disruptions in water service delivery.
H1: Ageing infrastructure is correlated with frequent disruptions in water service delivery.

Hypothesis 7

H0: Infrastructure backlog is not linked to frequent disruptions in water service delivery.
H1: Infrastructure backlog is linked frequent disruptions in water service delivery.

Hypothesis 8

H0: The quantity of water demanded does not have an association with whether there is frequent water disruptions or not.
H1: The quantity of water demanded has an association with whether there is frequent water disruptions or not.

Hypothesis 9

H0: The amount of litres per capita per day does not have a linkage with whether there is frequent water disruptions or not.
H1: The amount of litres per capita per day has a linkage with whether there is frequent water disruptions or not.

Hypothesis 10

H0: The amount of households having piped water inside a dwelling does not have a linkage with whether there is frequent water disruptions or not.
H1: The amount of households having piped water inside a dwelling has a linkage with whether there is frequent water disruptions or not.

Hypothesis 11

H0: The amount of female headed households does not have a linkage with whether there is frequent water disruptions or not.
H1: The amount of female headed households has a linkage with whether there is frequent water disruptions or not.

Hypothesis 12

H0: The quality of discharged effluent does not have an association with whether there is frequent water disruptions or not.
H1: The quality of discharged effluent has an association with whether there is frequent water disruptions or not.

Hypothesis 13

H0: The amount of water in dams did not have an association with whether there were frequent water disruptions or not.
H1: The amount of water in dams had an association with whether there were frequent water disruptions or not.

Hypothesis 14

H0: The amount of water loss does not have an association with whether there are frequent water disruptions or not.
H1: The amount of water loss has an association with whether there are frequent water disruptions or not.

Hypothesis 15

H0: The low income households as a percentage population does not have an association with whether there are frequent water disruptions or not.
H1: The low income households as a percentage population have an association with whether there are frequent water disruptions or not.

Hypothesis 16

H0: The number of informal households on RDP level as a percentage of the population having water does not have an association with whether there are frequent water disruptions or not.
H1: The number of informal households on RDP level as a percentage of the population having water has an association with whether there are frequent water disruptions or not.

Hypothesis 17

H0: The total number of households below the RDP level on sanitation is not associated with frequent water disruptions.
H1: The total number of households below the RDP level on sanitation is associated with frequent water disruptions.

4.6.1 RESEARCH PROPOSITIONS RELATING TO THE SECOND OBJECTIVE

Since only descriptive statistics will be used to analyse the data on the perceptions of the relevant municipal officials obtained through the dissemination of a survey questionnaire, the second objective will be translated into research propositions. Research propositions are used in circumstances where no inferential statistical approach is being used ad where only qualitative or descriptive approaches are being adopted.

The second research objective is translated into the proposition that the relevant municipal officials have definitive perceptions about the factors causing water supply disruptions.

Stemming from the second proposition, the following sub-propositions emerge:

Proposition 1: The perceptions of municipal officials is that ageing infrastructure, water storage capacity, water quality (colour, smell and taste), poor effluent discharged in water resources, lack of water treating technologies, water loss , amount of water used by commercial farmers, institutional arrangement, strikes, debts from consumers, revenue raising capacity, number of poor households, metering, non-payment for water services, low equitable share grant and conditional grants, tariffs not reflecting cost, water demand, town development, droughts, electricity disruption and skill shortage does not cause frequent disruption in municipalities.

Proposition 2: The perceptions are that ground water, surface water and average rain fall is a problem in municipalities that does not lead to disruption in water supply.

Proposition 3: The perceptions are that different infrastructure is not a concern in municipalities.

Proposition 4: Skill shortages for Engineers, Process Controllers and Leadership do not have impact on the frequency of disruption.

Proposition 5**:** The feeling is that poor areas do not experiencing more frequent disruptions than their rich counterpart.

4.7 MODEL SPECIFICATION

The logistic model will be used to model archival data using inferential statistical approaches. This model has become the standard method of analysis in situations demanding a description of the relationship between a binary response variable and one or more explanatory variables. According to Gujarati and Porter (2009), what distinguishes a logistic regression from the linear regression model is that the outcome variable in logistic regression is binary or dichotomous. This model is a probability model because two categories in the dependent variable are qualitative (Gujarati and Porter, 2009). The analysis of the logistic regression model assumes the outcome variable is a categorical variable; it is common practice to assume that the outcome variable is the dichotomous variable and it is labelled a success or failure (Heij, de Boer, Franses,

Kloek and Dijk 2004). The binary dependent variable y, takes on the values of zero and one (Gujarati and Porter, 2009).

Rana, Midi, and Sarkar (2010) note that the Logistic model enables one to estimate Pr(Y|X) the conditional probability distribution of the response Y, given the vector input variables (X). Pr(Y|X) indicates how precise the prediction of Y, assuming a particular outcome is, given the vector of predictor variables (X). The need to model the conditional probability $\Pr(Y = 1|X = x)$ as a function of x, means that any unknown parameters in the function are estimated by maximum likelihood.

Szumilas (2010) points out that an odd ratio measures the relationship between an experience and outcome. The odd ratio shows that an outcome will occur given a particular experience compared to the odds of the outcome occurring in the absence of the experience. The odds are the ratio of probability of the events occurring divided by the probability that the event will not occur.

The formula is as follows:

$\text{odd}_i = \frac{\text{success}}{\text{failuire}} = \frac{\pi_i}{1-\pi_i}$ where π_i is the probability of success and $1 - \pi_i$ is the probability of failure. (1)

Odds are the ratio of the probability that always have a value greater than zero. If the odds value is larger than one, it means that success will be more likely to occur than failure. For example if the odds value is 4, the expectation is that of four successes for every one failure and if the odds value is a quarter, a reverse may occur. Grimes and Schulz (2008) note that the odds ratio is as follows:

$$oddsratio = \frac{\frac{\pi_1}{1-\pi_1}}{\frac{\pi_2}{1-\pi_2}} \quad (2)$$

Suppose π_1 and π_2 refer to the probability of success both group 1 and group 2 respectively. If the odds ratio is greater than one, it indicates that the odds of the group 1 are greater than in

group 2. Therefore, subjects in group 1 are more likely to have success than subjects in group 2. Let us assume that the odds have a ratio of less than one, then we expect that the opposite will occur. While if it is equal to one subject, the odds of both group 1 and group 2 will be equally likely to occur.

Abdelrahman (2013), notes that the odds of an event lie between zero and positive infinity and also that 1 is the base line for odds, as a result, the natural logarithm of odds have no boundaries of domain. The odds lie between negative and positive infinity while zero is the base line for natural logarithm of odds.

In this study, the dichotomous variable Y represents water supply disruptions outcomes (dependent variable). The dependent variable Y takes value of Y=1, if the water supply disruption is frequent and Y= 0, if the supply disruption is not frequent. In order to undertake a quantitative analysis, towns are classified into two categories: those that experience frequent disruption and those that do not experience frequent disruptions. Frequent disruptions are defined as the disruptions that occurred 30 percent or more based on total water disruption monitoring calls that were made by Department of Water and Sanitation to check the status of disruption each month from different towns per Municipality between April 2016 and July 2016. The calls are made at least twice a week. The Department of Water and Sanitation calls municipalities to ask them report on the status of disruption on their different towns. The same numbers of calls are made each month but sometimes in a particular day about one or two municipalities are not reached. Collected information was enough to do the analysis to determine whether the disruption was frequent or not. The less or non-frequent disruptions are those that happened less than 30 percent. It should be noted, however that, the study also attempts to get the April-July data for 2014 and 2015 in order to achieve more robust results through pooling the data and then conducting the analysis.

Explicitly the logit model considers the log odd $\left(\ln\frac{\pi_i}{1-\pi_i}\right)$ of having frequent water supply disruptions as a function of a set of independent variables. In municipalities, these factors are linked to either enhance or decrease the probability of Y taking on the value 1 (ie.π_i =Frequent water supply disruption).

The logistic regression model can be expressed as follows:

$$Y_i = \ln\left(\frac{\pi_i}{1-\pi_i}\right)=\beta_0 + \beta_1X_1 + \beta_2X_2 +\beta_3X_3 + \beta_4 X_4 +\beta_5X_5 +\beta_6X_6 +\beta_7X_7 + \beta_8X_8 +\beta_9X_9 + \beta_{10}X_{10} +\beta_{11}X_{11} + \beta_{12}X_{12}+\beta_{13}X_{13} + \beta_{14} X_{14} + \beta_{15}X_{15} + \beta_{16}X_{16} + \beta_{17}X_{17} +U_i \quad (2)$$

Where:

ln is the natural logarithm

π_i is the probability that event Y_i =1 frequent water supply disruption as a result of the Xi factors.

1- π_i is the probability that event Y_i =0 occurs or alternatively, $Y_i \neq 1$ does not occur which is Fail.

β_0 = is the coefficient on the constant term

X_1 = poor maintenance (1 or 0)

X_2 = Water storage capacity in kilolitres

X_3 = grant disbursement per town

X_4 = number of low income households

X_5 = number of households

X_6 = ageing infrastructure

X_7= infrastructure backlogs

X_8 = quantity of water demanded

X_9= litres per capita per day

X_{10} = piped water inside dwelling

X_{11} = female headed households

$X_{12=}$Quality of effluent discharged

X_{13}= amount of water in dams

X_{14}= water loss

X_{15}= low income as percentage of the population

X_{16}= informal households on RDP level as a percentage of the population having water

X_{17}= total households below the RDP level on sanitation

ui= Error term

4.8 THE EMPIRICAL AND THEORICAL LITERATURE USED TO IDENTIFY FACTORS ASSOCIATED WITH DISRUPTION IN WATER SUPPLY

The study examines the factors the hinder the service delivery. The methodology used is most likely to identify the factors hinder the service delivery.

The South African media has reported on service delivery protests over the last decade or more, the frequency of which appears to be rising as marginalised communities continue to complain about appalling local government delivery of water, electricity, sanitation and housing. At times communities resort to violent mass action (Pretorios and Schurink, 2007).

Pretorious and Schurink (2007) note that post-apartheid South Africa faces a major challenge in ensuring that municipalities provide optimal and professional services to citizens of heterogeneous cultures. The post-1994 ANC led government inherited a fragmented local government system that was biased against black South Africans as it used to cater for the needs of whites. In 2005, the then Minister of local Government, Mr Sidney Mufamadi, noted that the democratic government faced the challenge of ensuring that all municipalities develop the requisite capacity to translate available resources into instruments that can alleviate poverty, underdevelopment and inequality. He also suggested that strategic interventions, which include public participation, programme management and the creation of conditions for sustainable service delivery and economic development must be marshalled to address the mentioned problems. Hence, service delivery has always been earmarked by government as a critical area of intervention with the monitoring of service delivery needs through effective governance and service administration being of paramount importance.

According to Koma (2010), the Weberian schools of thought seek to address the social and economic needs of citizens particularly the poor and previously disadvantaged individuals. Algotssom et al (2009) noted that both the Water Service Acts and Strategic Framework for Water Services delineate the powers, functions and duties of Public service delivery. These powers, functions and duties include the provision of physical infrastructure, good governance and social programmes that will address underdevelopment and inequality and thereby create prosperous communities. Pretorious and Schurink (2007) note the activities required for such ends and these include the aims, priorities, futures, goals, critical issues to solve, challenges and threats to confront, and opportunities to exploit or build. Pretorious and Schurink (2007) also define the specific relationships that need to be established between government, private and social actors in order to achieve the targeted social goals.

Hogg and Samson (2011) note that the South African government's idea of good governance is based on the Batho Pele Principles. The Batho Pele Principles put people first and involve the notion of consultation in public administration. Citizens should be consulted about the level and quality of the public services they receive and, wherever possible, should be given a choice about the services that are under offer. The principles state that caring government officials should offer the highest service standards to all in a respectful manner. In addition, government services ought to be accessible to all and that informed decisions in service delivery should be made in an open and transparent manner to redress the past inequities and offer value for money to its all citizens.

The concept of 'good governance', has in recent times been used in developing countries as a reference to demand for a new way of governing that is better suited, responsive and effective in order to meet the new social conditions and problems. However, according to the Water Partnership Program (2010), the concept of governability is highly familiar and used more frequently in emerging market economies due in part to the concern that recent democratic governments could be overran by the many problems, needs and conflicts distressing society, and that it could be ill equipped or incapable to respond properly and steer society towards better levels of living. The democratic government's inheritance of un-governability is considered a likely political scenario if the pattern of the authoritarian pre-democratic governance is reiterated

by the practices of several newly instated democratic governments. Hence, an effective democratic government should provide goods and services that citizens demand with efficiency and honesty.

However, the developing countries' governments face three generic challenges that explain why governments need to continue reforming. The first challenge is that the public administration is a monopoly supplier; it is the sole supplier of most of the public goods and services it provides. The next two challenges may be termed the principal-agent problem, with the second involving the way the electorate (principals) get politicians (agents) to fulfil their wishes with the difficulty arising where political institutions purporting to represent voters do not work for the quality and quantity needs of the voters. The third involves the difficult that politicians (principals) face as they try to control public employees (agents). The latter two problems arise because it is extremely difficult to define and quantify with precision the various public goods and services, which in turn contributes to the challenges of monitoring and evaluation of employee performance. Moreover, unlike the private sector products, it is not easy to subject typical government outputs to the test of the market (Batley and Mcloughlin, 2015).

Western democracies have developed systems, over the past two centuries, which restrict the freedom of politicians and public servants to act outside the public interest and thus create a professionalised public service. These countries generally have honest, efficient and competent public administrations delivering a wide range of public goods and services.

According to Hogg and Samson (2011), the curb on the powers of politicians and public servants occurred through the adoption of checks and balances where the politicians oversee the implementation of policies but are subjected to rules that limit their interference in the professional public administration. There also exist other institutions, such as an independent judiciary and neutral public auditor, which provide independent and external oversight. South Africa has adopted similar institutions but the system of appointing party officials, popularly known as cadre deployment in administration, and rent seeking behaviour among politicians and public servants is widespread.

Western Societies also imposed command-and-control approaches to governance where hierarchical and centralised forms of organisation of the public administration and career public servants are responsive to the electorates' mandate, but insulated from individualised political influence. Suitably qualified staffs are employed on a meritorious basis; under rules that relate salary scales to clear job descriptions; provide fair and transparent mechanisms for hiring, firing, and promotion; and offer permanent positions and other non-salary related incentives. Additionally, budgets, planned income and expenditure are professionally managed by public servants. These public servants make reliable forecasts through following accurate codified procedures using trustworthy records and rigorous financial systems put in place to check that expenditures are made honestly and in accordance with the set budgets. South Africa has introduced similar systems, however, the systems are fraught with inefficiency and inflexibility, despite the existence of ward committees and other avenues for public participation. In addition, public expectations over goods and services provided by local government, far exceeds the actual delivery of such services (Hogg and Samson, 2011).

This study is, therefore, focused on the monitoring and evaluation, a critical function if a system of good governance is to be entrenched at the local government level. Specifically, this study focuses on good governance in water service delivery through analysing a range of variables obtained from the Free State Local Government database. It is hoped that the quantitative analysis of this data will identify the specific areas of governance that requires the attention of the Free State local government authorities. The study also administered a questionnaire to officials in the water services division to ascertain their views on the causal factors of water disruptions.

4.8.1 VALIDITY AND RELIABILITY TESTS

The Z and Wald tests are used to confirm the validity and reliability of the regressors affecting the dependent variable. The Hosmer Lemeshow test and McFadden R-squared are also used to test the overall robustness of the model.

4.8.1.1 THE Z AND WALD TEST

The Wald test can test hypothesis handle regression models irrespective of whether they are linier or not. Asymptotically, the Wald test is equivalent to the likelihood and Lagrange multiplier tests (Gujarati and Porter, 2009). According to Bewick, Cheek and Ball (2005), Wald statistics are utilised to test the significance of separate coefficients in the model and is calculated like this:

$$(\text{Coefficient} \div \text{SE coefficient})^2$$

Wald statistics is effective for large samples. The likelihood ration test is considered a better test. The likelihood test for specific parameter is compared to the likelihood of obtaining data when the parameter is zero (X_0) with the likelihood (X_1) of getting data evaluated at the maximum likelihood estimate of the parameter. The test is as follows:

$$-2 \times \ln(X_0 / X_1) = -2 \times (\ln X_0 - \ln X_1) \qquad (3)$$

Gujarati and Porter (2009) note that the Z test is as follows:

$$Z_i = \frac{A - \mu}{\alpha / \sqrt{n}} \qquad (4)$$

Where A and n are known or can be projected but α and μ cannot be projected or are not known. But if α is specified, the assumption is $\mu = \mu^*$. If the probability is less than 5 per cent or 1 per cent the null hypothesis is rejected. A true hypothesis indicates that the likelihood of obtaining Z should be very high.

4.8.1.2 THE HOSMER-LEMESHOW TEST

The study uses Hosmer-Lemeshow test to assess whether or not the observed is in line with the expected event rate in subgroups of the model population. The Hosmer-Lemeshow test is a statistical test for goodness of fit for logistic regression models that is achieved by forming ten organised sets of subjects and comparing the actual number in every single group that is

observed to the number predicted by the logistic regression model (Takma, isci Guneri and Gevrekci 2016).

The Hosmer-Lemeshow test statistic is achieved using this formula:

$$H= \sum_{g=1}^{G} \frac{(O_g - E_g)^2}{N\, g\pi g(1-\pi_g)} \quad (5)$$

Here, O_g,$E_{g'}$,N_g and π_g denote the observed events, expected events, observations, predicted risk for the g^{th}risk decile group with G as the number of groups. The test statistic asymptotically follows χ^2 distribution (Rana et al, 2010).

4.8.1.3 THE MCFADDEN R-SQUARED TEST

The test focuses on logistic regression models that are fitted using the method of maximum likelihood. The parameter estimates are the values that maximise the likelihood of the data which would have been observed. According to Allison (2014), McFadden R^2 is one of the R^2 that is used frequently than others. This study uses McFadden's R^2.

The McFadden's R squared test is explained as:

$$R^2 \text{ McFadden} = 1 - \ln(L_1) / \ln(L_0) \quad (6)$$

Where L_1 denotes the maximised likelihood value from the current fitted model, and L_0 denotes the corresponding value for the null model, the model with only intercept and no covariates. One can suppose, in trying to comprehend whether this definition makes sense that, the covariates in our current model give no predictive information about the outcome. For individual binary data, the likelihood contribution of each observation is between 0 and 1 (a probability), and so the log likelihood contribution is negative. If the model has no predictive ability, although the likelihood value for the current model will be (it is always) larger than the likelihood of the null model, it will not be much greater (Allison, 2014). Therefore the ratio of the two log-likelihoods will be close to 1, and R^2 McFadden will be close to zero, as we would hope.

Suppose our current model explains virtually all of the variation in the outcome, which we shall denote as Y. Considering that the logistic regression model's purpose is to give a prediction for

P(Y=1) for each subject, we would need P(Y=1) ≈1 for those subjects who did have Y=1, and P(Y=1)≈0 for those subjects who had Y=0. If this is the case, the probability of seeing (Y=1) when(Y=1) ≈1 is almost 1, and similarly the probability of seeing Y=0 when P(Y=1)≈0 is almost 0. This means that the likelihood value for each observation is close to 1. However, one could not always expect to find predictors that are strong enough to give predicted probabilities so close to 0 or 1 and thus one should not be much surprised if one attains a value of R^2 McFadden which is not very large.

4.8.2 DESCRIPTION AND MEASUREMENT OF VARIABLES

4.8.2.1 DEPENDENT VARIABLES

Two dependent variables are used in the analysis of frequent disruption of water supply, and non-frequent disruption of water delivery. The measurement of the disruptions is achieved through a classification of the towns are classified into two categories: those that experience frequent disruption and those that do not experience frequent disruption. Frequent disruptions are defined as the disruptions that occurred 30 percent or more based on total water disruption monitoring calls that were made by Department of Water and Sanitation to get information on disruption each month from different towns in a Municipality between April 2016 and July 2016. The calls are made at least twice a week. The Department of Water and Sanitation calls municipalities to ask them report on the status of disruptions on their towns. The same numbers of calls are made each month but sometimes in a particular day about one or two municipalities are not reached. Collected information was enough to do the analysis to determine whether the disruption was frequent or not. The less or non-frequent disruptions are those that happened less than 30 percent.

4.8.2.2 INDEPENDENT VARIABLES

The maintenance of the water system is the central variable with two choices created representing 1 for poor maintenance and 0 for good maintenance. Water storage capacity is indicated as 1 for poor storage capacity and 0 for enough storage capacity. Grant disbursement

per town is measured on the amount of money. The number of low income households and number of houses per household are indicated by numbers. Two ageing infrastructure variables are created; 1 for old infrastructure and 0 for not old infrastructure. The variables for infrastructure backlog consist of 1 for huge backlog and 0 minor backlogs. The quantity water demanded and litres per capita are indicated by the numbers. Pipe water inside dwelling and female headed households is indicated by percentages. The quantity of effluent discharged has two options; 1 for poor and 0 for reasonable. The amount of water in dams has two choices; 1 reasonable level and 0 for low. Water losses are indicated by percentage. The last variables are % percentage low income households, percentage of informal households on RDP level on water and total below RDP for sanitation.

Table 4.8.2.2: Summary of Variables used in the Logistic regression

Dependent Variable	
Water disruption outcome	Y_i = Frequent disruption = 1 or Y_i = not frequent disruption = 0
Explanatory variables	
Maintenance of water system (MWS)	MWS considers the impact of maintenance on the frequency of water supply disruptions. If the maintenance is poor it is coded 1 while good maintenance the code is 0.
Water storage capacity (WSC)	WSC indicates the impact of storage capacity on water disruptions. WSC include both the quantity and quality of the storage. If the storage capacity is poor storage it is coded 1 while a good storage capacity is coded 0.
Grant disbursement per town (GD)	GD considers the impact of amount spent per town in 2016 in the municipality.
Number of households (NH)	NH focuses on the impact of total number of

	households on the frequency of disruptions.
Ageing infrastructure (AI)	AI reflects the impact of the age of infrastructure on the frequency of disruption. If that infrastructure is old it is coded 1 and 0 for not old infrastructure.
Quantity of water demanded (QWD)	QWD concerns itself with the impact of water demand on the disruptions of water services.
Piped water inside dwelling (PWID)	PWIN focuses on the influence of the level of services on the frequency of disruption.
Female headed households (FHH)	FHH considers the impact of female headed households on the frequency of disruption.
Quality of effluent discharge (QED)	QED examines the impact of quality of water that is discharged on water resources. The code determines whether the quality of effluent discharged is poor or is reasonable.
Amount of water in dams (AWD)	AWD looks into the level of water in dams. If the percentage of water in 50% or more it is considered reasonable and if 49% or less it is considered low. If the level of water is reasonable the code is 0 and if the level of water is low the code is equal to 1.
Infrastructure Backlogs (IB)	IB examines the infrastructure that still needs to be done. If there large amount of infrastructure that is still to be done the code is 1 and when low amount of infrastructure that has to be done the code is 0.
Quality of effluent discharge (QED)	QED looks into whether the discharge effluent

	meets the standard or not set by the Department of Water and Sanitation.
Water loss (WL)	WL refers to the amount of water that is lost through leakages or theft. This water is indicated as a percentage.
Low income as percentage of population (LIPP)	LIPP indicates the influence of low income households on the frequency of water supply disruption.

4.9 THE SURVEY QUESTIONAIRE

The aim of the survey was to assess the perceptions of municipal officials working with the water division regarding the causes of frequent water disruptions. Qualitative and quantitative data was collected through the use this questionnaire which comprises both closed and open ended questions. The questionnaire will be administered to a minimum of 3 key informants (high ranking administrators, water engineers and other senior technicians) from the 20 municipalities.

4.9.1 INFORMATION ON THE INTERVIEWS

The initial plan was to carry out 60 standardised interviews with three officials per municipality. The three representatives were selected based on the assumption that they understand issues of water in their municipalities. These include Technical Managers, Engineers and Technical Officers who work in the water division of municipalities. The returned questionnaires are 40 from a sample frame of 60 which indicate a 66% response rate, hence, the endeavour was a success and the results obtained are trustworthy. Only one municipality was not represented in the survey. Most of the questionnaires were administered from about 09h00 to 16h00.The questionnaire was developed using data obtained from empirical literature. I was intentional in simplifying questions so that the question is well understood by respondents. It took about 30 minutes for the respondents to fill the questionnaire. After the survey, the data was put into an

excel sheet. Subsequent of selected variables and graphs were created as part of the analysis of the findings.

The full questionnaire can be found in an Appendix at the end of the thesis. It includes the following:

1. Information about the respondent

I first gathered data on the gender and position of the respondent in the municipality.

2. Causal factors for disruption

I gathered data on listed factors that are likely to increase the probability of disruptions in water supply. The respondents were expected to choose one from five options ranging from strongly agree to strongly disagree.

3. Concerns with regard to natural resources

The respondents also chose from five options ranging from strongly agree to strongly disagree on the issue concerning natural resources.

4. Source of bulk supply

Respondents were asked about whether they prepare their own bulk water or use a Water Board for bulk supply.

5. Information on poor households

The questions asked on how the municipality supplied free water to poor households according to the Indigent Policy. In addition the respondents were asked if the municipality has meters on all households receiving free basic water. They were also asked what happens if a consumer uses far more water than the 6 KL allocated based on Indigent Policy for drinking water.

6. Information on skills shortages

The questions regarding this factor were about skills shortages, especially that of Engineers, Process Controllers and Leadership. The respondents were given five choices which are strongly agreed, agree, not sure, agree and strongly agree.

7. Information on the major drivers of disruption

This question, which was an open-ended one, requested respondents to indicate what they considered as the major drivers of disruption in their municipalities and to explain what they thought can be done to avoid disruptions in the municipalities.

8. Rich versus Poor Township

The question sought data on the townships that are affected more by water interruptions and those that are not affected frequently by disruptions in water supply. Those interviewed were expected to mention areas that are affected by the disruption in their municipalities and to determine whether or not poor townships are affected more by disruptions.

9. Information on water supply complaints

The respondents were also asked about the frequency of complaints they receive from customers.

4.10 CONCLUSION

This chapter focused on the research design and methodology used in the study. It highlighted how the data was collected and made a detailed description of the manner in which the dichotomous dependent variable involving disruption in water service was identified and appropriately coded. The chapter also discussed the Wald and Z tests and the diagnostic tests

such as the Hosmer-Lemeshow and McFadden R^2 .Lastly, the chapter discussed was collected using the questionnaire.

CHAPTER 5

5.1 INTRODUCTION

The study explores the relationship between the dependent variable (water supply disruption outcome) and independent variables (poor maintenance, water storage capacity, grant disbursement per town, number of low income households, ageing infrastructure, quantity of water demanded, households with piped water inside dwelling, female headed households, quality of effluent discharged, amount of water in dams, water loss and low income households as a percentage of population) that were collected from archived data on municipalities. This study focus is linked to with the main objective, which is to investigate the factors that cause water supply interruptions in the Free State Province. The second objective was to assess the perceptions of municipal officials involved in the water division as to the causes of frequent water disruptions. The perception was revealed from the questionnaires. As a result, this chapter presents and discusses both the logistic regression used to analyse the archival data and the survey results based on the data collected from the questionnaires. The chapter also analyses, interprets and discusses the research findings.

5.2 DATA ANALYSIS

The statistical package for social sciences (SPSS) was used to scrutinise the statistics. The study used SPSS which has a variety of advanced functionalities to estimate and present the descriptive statistics of data obtained from the coded questionnaires. The SPSS was utilised further to perform statistical analyses, regression analyses and cross tabulations.

5.3 THE LOGISTIC REGRESSION MODEL

As highlighted in Chapter 4, this study employs logistic regression to investigate the factors that hinder service delivery in the Free State Province. This subsection begins with a detailed analysis of the results obtained from the logistic regression. The interpretation of the logistic regression results is followed by an outline of the tests that were employed to verify the model. The validation of the model is carried out to ensure that there are no data errors that were incurred during data capturing and also to identify significant observations.

The logistic model was used to predict the probability of frequent disruption in water supply. This study modelled frequent disruption as a dichotomous variable and if there was frequent disruption then the variable was coded 1 while if the disruption was not frequent the variable was coded as 0. The variables and their selection have been explained in detail in the preceding chapter. What is now remaining is to discuss the results; hence this section presents the research findings. However, before proceeding to the research findings, it is worth mentioning that a two-tailed test of significance was used to determine the acceptance or rejection of the null hypothesis in order to assess the reliability of point estimates. For the purpose of this study, a one percent, five percent and ten percent level of significance were used. The logistic regression initially used poor maintenance (PM), water storage capacity (WSC), grant disbursement per town (GDT), number of low income households (NLH), number of households (NH), ageing infrastructure (AI), infrastructure backlogs (IB), quantity of water demanded (QWD), litre per capita per day (LPD), households with piped water inside dwelling (PWID), female headed households (FHH), quality of effluent discharged (QED), amount of water in dams (AWD), water loss and low income households as a percentage of the population (LIPP), informal households on RDP level (INRDP) and total households below RDP level on sanitation (THBRDPS) to predict the probability of water supply disruption.

$$\ln\left(\frac{\pi_1}{1-\pi_1}\right) = \beta^0 + \beta^1 PM_{\mathrm{i}} + \beta_2 WSC_{\mathrm{i}} + \beta_3 GDT_{\mathrm{i}} + \beta_4 NH_{\mathrm{i}} + \beta_5 NLH_{\mathrm{i}} + \beta_6 AI_{\mathrm{i}} + \beta_7 IB_{\mathrm{i}} + \beta_8 QWD_{\mathrm{i}} + \beta_9 LPD_{\mathrm{i}} + \beta_{10} PWID_{\mathrm{i}} + \beta_{11} FHH_{\mathrm{i}} + \beta_{12} QED_{\mathrm{i}} + \beta_{13} AWD_{\mathrm{i}} + \beta_{14} WL_{\mathrm{i}} + \beta_{15} LIPP_{\mathrm{i}} + \beta_{16} INRDP_{\mathrm{i}} + \beta_{17} THBRDPS_{\mathrm{i}} + u_{\mathrm{i}}$$

After using the validity tests, some explanatory variables were eliminated see "appendix B" and the model was left with variables that are fit to be used as listed on "appendix B1". The model then looks like this:

$$\ln\left(\frac{\pi_1}{1-\pi_1}\right) = \beta^0 + \beta_1 \ PM_i + \beta_2 WSC_i + \beta_3 GDT_i + \beta_4 NH_i + \beta_6 AI_i + \beta_8 QWD_i$$
$$+ \beta_{10} PWID_i + \beta_{11} FHH_i + \beta_{12} QED_i + \beta_{13} AWD_i + \beta_{14} WL_i + \beta_{15} LIPP_i + u_i$$

Nineteen independent variables were collected from the databases of the 20 Free State Municipalities with 12 deemed appropriate for entering into the logistic regression model after carrying out the various tests mentioned in Chapter 4. Poor maintenance, ageing infrastructure, amount of water in dams and low income as a percentage of the population were identified as statistically significant in impacting on the frequency of water disruptions among the 20 municipalities. The logistic regression involved 71 towns because there was no data for some few towns.

5.3.1 RESULTS OF THE LOGISTIC REGRESSION MODEL

The Appendix contains the logistic regression model that included all the 19 variables. After the appropriate variables were identified, the logistic regression contained only the identified variables.

Table 5.3.1: Logistic Regression results

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-2.811158	1.517996	-1.851888	0.0640
X1	1.248931	0.591639	2.110968	0.0348
X6	1.158341	0.652127	1.776252	0.0757
X13	-1.004144	0.587864	-1.708122	0.0876
X15	0.040124	0.023179	1.731054	0.0834

McFadden R-squared	0.175451	Mean dependent var	0.609375
S.D. dependent	0.491747	S.E. of regression	0.456738

variable			
Akaike info criterion	1.259541	Sum squared resid	12.30798
Schwarz criterion	1.428204	Log likelihood	-35.30532
Hannan-Quinn criterion.	1.325986	Deviance	70.61063
Restr. Deviance	85.63544	Restr. log likelihood	-42.81772
LR statistic	15.02480	Avg. log likelihood	-0.551646
Prob(LR statistic)	0.004650		

Source: Author's own calculations

The table above shows the results of the logistic regression analysis. The coefficient on poor maintenance (X1) is highly statistically significant at the 5% level of significance, which may be interpreted as showing that a municipality that is plagued by poor maintenance problems increases the log-odds of frequent water disruptions by 1.25. The results from taking an antilogs and subtracting 1 (see Gujarati and Porter (2009), suggest that poor maintenance increases the probability the odds of frequent disruptions by 249 percent which is a serious problem for municipalities. Poor maintenance falls in the domain of existing weak management systems and is directly linked to the difficulty of holding municipal staff accountable. Poor maintenance is also linked to what van Zyl's (2014) observation that less money is allocated for on-going maintenance. As a result, poor maintenance is associated with deterioration of infrastructure and poor service delivery.

Ageing infrastructure was identified as another critical problem affecting a municipality's ability to prevent the frequency of water disruptions at the conventional 10% statistical significance level. The log-odds value of frequent water disruptions is 1.15 which suggests that ageing infrastructure increases the odds ratio of the frequency of disruptions by an extremely high 216%. On the surface, this problem might reflect lack of resources but it could imply that there exist poor management systems in place and the lack of the requisite skills for forward planning and accessing the available funding at central government level or a failure to attract private sector funding through means such as bond issuance. The existence of infrastructure problems might also suggest that the local authorities do not have policies in place to bring in private partners.

The level of water available in the dam/s is another critical factor influencing water disruptions and it is at the 10% significance level. High dam water levels reduce the log-odds of frequent water by 1.004. This suggests that high dam water levels reduce the odds ratio of frequent water disruptions by 63.4%. The challenge of low dam levels coupled with poor maintenance and ageing infrastructure, exacerbates the problem and implies that the local authorities lack the capacity and resources to strategically conserving water through fixing leaks and finding other sources of water such as sinking boreholes.

Communities with low income levels are another significant factor that explains the increased frequency of water disruptions at the 10% statistical level of significance. A rise in the percentage of the town population with low income causes a further rise in the log-odds frequency of water disruptions by 0.04. The implication is that when a community becomes poor, owing to a rise in the number of people with low incomes, then the frequency of water disruptions increases by 4.1%. This suggests that poorer communities might default on their utility bills and in turn affect the services that municipalities provide to those communities. Where there is more poor communities it is linked to a higher frequency of disruptions.

5.4 DIAGNOSTIC TESTS

The diagnostic tests that were employed in this study – as explained in detail in the preceding chapter- are the Hosmer-Lemeshow test which assessed the goodness of fit, and the Wald test statistic which serves as a T-statistic for the logistic regression model.

5.4.1 THE HOSMER-LEMESHOW TEST

To assess the validity of the model, the study employed the Hosmer-Lemeshow (HL) test. By definition, the Hosmer-Lemeshow test is a statistical test used to assess the goodness of fit of a given model. The goodness of fit assists on deciding whether the model is correctly specified or not. According to Hosmer, D Hosmer T, Le Cessie, and Lemeshow (1997), the rule of thumb for the test is that a good model will have a small Hosmer and Lemeshow test statistic and a P-value that is greater than 0.05 (the significant level). Furthermore, if the HL test is significant at 1%,

5% or 10%, the suggestion will be that the model does not fit the data and therefore the model cannot be trusted.

Table 5.4.1: Hosmer-Lemeshow Test

Table A: Logistic Regression with all possible causal factors

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-4.077645	5.390338	-0.756473	0.4494
X1	2.222288	1.072949	2.071196	0.0383
X2	-0.923141	0.906406	-1.018464	0.3085
X3	6.93E-09	1.48E-08	0.469354	0.6388
X4	-0.000202	0.000177	-1.139872	0.2543
X6	1.723926	1.114397	1.546958	0.1219
X8	6.66E-08	1.98E-07	0.336475	0.7365
X10	2.401081	2.523053	0.951657	0.3413
X11	1.003505	9.465488	0.106017	0.9156
X12	-0.357617	0.860097	-0.415787	0.6776
X13	-1.785336	0.871414	-2.048780	0.0405
X14	-2.249495	4.853115	-0.463516	0.6430
X15	0.061103	0.035392	1.726445	0.0843

McFadden R-squared	0.272541	Mean dependent var	0.615385
S.D. dependent var	0.491251	S.E. of regression	0.471905
Akaike info criterion	1.469381	Sum squared resid	8.685081
Schwarz criterion	1.957192	Log likelihood	-25.20391
Hannan-Quinn criter.	1.656396	Deviance	50.40782
Restr. Deviance	69.29296	Restr. log likelihood	-34.64648
LR statistic	18.88514	Avg. log likelihood	-0.484691
Prob(LR statistic)	0.091338		

Obs with Dep=0	20	Total obs	52
Obs with Dep=1	32		

Source: Author's own calculations

The above HL test compared the predicted values with the actual values of the dependent variables. The results confirm that the model employed in this study is correctly specified and adequately fits the data.

5.4.2 THE WALD STATISTICS TEST

A Wald statistic test was used to assess the contribution of individual predictors in our model. The Wald statistics test was employed, in a way similar to the T-test in linear regression, to assess the significance of coefficients in our model. The rule of thumb with regards to the Wald statistic test is that the null hypothesis is rejected if the P-value of the test is less than 0.05 (significant level). Furthermore, a coefficient with a P-value of the Wald statistic that is less than 0.05 implies that the variables are important in the model.

Table 5.4.2: Wald Test

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-2.811158	1.517996	-1.851888	0.0640
X1	1.248931	0.591639	2.110968	0.0348
X6	1.158341	0.652127	1.776252	0.0757
X13	-1.004144	0.587864	-1.708122	0.0876
X15	0.040124	0.023179	1.731054	0.0834

McFadden R-squared	0.175451	Mean dependent var	0.609375
S.D. dependent var	0.491747	S.E. of regression	0.456738
Akaike info criterion	1.259541	Sum squared resid	12.30798
Schwarz criterion	1.428204	Log likelihood	-35.30532
Hannan-Quinn	1.325986	Deviance	70.61063

criter.			
Restr. Deviance	85.63544	Restr. log likelihood	-42.81772
LR statistic	15.02480	Avg. log likelihood	-0.551646
Prob(LR statistic)	0.004650		

Source: Author's own calculations

The above table (5.4.2) shows that the Wald stat test results indicate that our model is significant. The variables included in the model will be able to predict a meaningful relationship of interest. Since the model is significant we therefore reject the null hypothesis that the variables are equal to zero.

5.5 RESULTS FROM THE SURVEY DATA

The survey questionnaire was distributed to 60 potential respondents and 40 were returned. The returned questionnaires indicate a 66% response rate, hence, the endeavour was a success and the results obtained are trustworthy.

5.5.1 HUMAN RESOURCES-RELATED FACTORS THAT CAUSE WATER SUPPLY DISRUPTION

Poor management and accountability structures, lack of skills and strikes are some of the challenges that are faced by local governments. Hogg and Samson (2011) note that an improvement of accountability can be achieved after reforming the public service. These challenges and the need for accountability are considered in the discussion on the study results that follow.

The results show that institutional arrangements involving weak management and accountability structures at the municipality accounts for poor service delivery and the high frequency of water supply disruptions. A sizeable 46.1% responded with an 'Agree' and 'Strongly Agree' response regarding weak management as leading to poor service delivery, while 28.2% state that it was

not a problem. There were a significant 25.6% of the respondents who indicated that they were not sure about poor management and accountability, which suggests that perhaps some of the respondents were uncomfortable with confirming the existence of both poor management and poor accountability in their municipalities.

A surprising majority of 69.2% of the respondents were of the view that strike activity is a cause of service delivery disruptions. In addition, only 15.4% of the respondents thought strike activity is a problem and cause of service delivery disruptions. One may expect strikes to increase disruption problems as strikes in South Africa generally tend to be violent with the demonstrators within a municipality often disrupting the pumping and delivery of water.

The results below further show that a skills shortage is perceived as a serious problem and leading to water supply disruptions. This is confirmed by 82% of the respondents who are of the view that skills shortage is a problem, whereas only 18% are in disagreement. The South African National Treasury (2011) notes the existence of skill shortages in small municipalities and the general skill deficit in local government are huge impediments to service delivery and governance. This finding corroborates the quantitative analysis undertaken above in regard to ageing infrastructure, poor maintenance and dam levels which in part may be linked to the challenges skills shortages in providing and maintaining the necessary infrastructure.

Table 5.5.1: Human Resources Related Responses

Item	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
Poor management and accountability structures	2,6%	25,6%	25,6%	33,3%	12,8%
Strikes	25,6%	43,6%	15,4%	15,4%	0,0%
Shortage of skills	2,6%	15,4%	0,0%	64,1%	17,9%

Source: Author's own calculations

5.5.2 MISCELLANEOUS FACTORS THAT CAUSE DISRUPTION IN WATER SUPPLY

Poor households cannot afford to pay cost recovery tariffs (Hemson, Dube, Mbele, Nnadozie and Ngcobo, 2006) and this may reduce the capacity of municipalities in providing good services.

The growth of a town may also reduce the capacity of municipalities to supply enough water. Finally, theft of cables and equipment contributes to water loss and supply interruptions (Ginger et al., 2013). These factors are considered in the study as noted in the discussion of the findings below.

The results show that 82.1% of the respondents 'Agree and 'Strongly Agree' to the assertion that the frequency of water disruptions is high in communities with a higher proportion of poor households, while only 12.9% 'Strongly Disagree' and 'Disagree'. This confirms the finding of the logistic regression model. In addition, 69.3% of the respondents view the rapid growth of the town as a major cause of the rise in the frequency of water disruptions while only 18% disagree. Electricity disruptions and cable theft which affect a municipality's capacity to pump water to residents are also viewed as a significant cause of water supply disruptions.

Table 5.5.2: Miscellaneous Causes of Water Disruptions

Item	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
The number of poor households	2,6%	10,3%	5,1%	51,3%	30,8%
Town expansion	2,6%	15,4%	12,8%	46,2%	23,1%
Electricity disruption and cable theft	0,0%	17,9%	2,6%	51,3%	28,2%

Source: Author's own calculations

5.5.3 INFRASTRUCTURE ISSUES THAT HAVE AN IMPACT ON THE FREQUENCY OF DISRPTIONS IN WATER SUPPLY AT LOCAL GOVERNMENT LEVEL

The construction of infrastructure in the water sector is frequently prioritised over investments in maintenance (Batley and Mcloughlin, 2015). This however, has consequences as noted by Van Der Zaag and Savenije (2006) that there are always risks of failures in water supply where maintenance is neglected. This section analyses the perception of municipal officials with regard to ageing infrastructure, water storage capacity and metering.

The table 5.3.2 below shows that ageing infrastructure is a leading factor towards increases in the probability of disruptions in water supply. About 97.5% of the interviewed respondents "agree

and strongly agree" that ageing infrastructure increase the probability of having disruption in water supply. This perception confirms the results of the logistic regression model that mentioned ageing infrastructure as one of the factors that negatively affect the provision of water services in the Free State Province. In addition, 67% of the interviewees agree that water storage capacity increases the probability of having disruptions in water supply. About 62.5% identified lack of metering as a problem that causes disruptions as people may waste water if they are not billed per consumption. Nonetheless, 30% disagree that metering is contributory factor to water supply disruptions.

Table 5.5.3: Infrastructure issues at Local Government Level

Item	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
Ageing infrastructure	0.0%	2.5%	0.0%	20.0%	77.5%
Water storage capacity	7.5%	20.0%	7.5%	42.5%	22.5%
Metering	5.0%	25.0%	7.5%	47.5%	15.0%

Source: Author's own calculations

5.5.4 THE FINANCE ISSUES THAT HAVE AN IMPACT ON THE FREQUENCY OF DISRUPTIONS IN THE FREE STATE

The rate of non-payment is high amongst the poorest. Banerjee *et al*. (2008) observed that non-payment is more on piped water than on electricity. This subsection analyses the perception of municipal officials on finance related issues.

Table 5.3.3 below demonstrates that non-payment for water services and other revenue raising capacity are seen by the respondents as the leading finance-related factor that increases the probability of having water supply disruptions. Nearly 95% of the respondents "agree" and "strongly agree" that non-payment is a cause of frequent disruptions while 92% were of the view that revenue raising capacity is a problem that leads to the disruption of water services delivery. About 77% agree that debt from consumers increases the likelihood of having disruptions in water services delivery. Exactly 59% of the respondents stated that a low equitable share and conditional grants increase the probability of having disruptions. Finally, 49% of the respondents

stated that neither the tariff nor reflecting costs increase the chances of having disruptions in water services delivery.

Table 5.5.4: Finance issues in the Free State Local Government

Item	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
Debts from consumers	2.6%	15.4%	5.1%	43.6%	33.3%
Revenue raising capacity	0.0%	5.1%	2.6%	59.0%	33.3
Non-payment for water services	2.6	0.0%	2.6%	51.3%	43.6%
Low equitable share and conditional grants	0.0%	12.8%	28.2%	35.9%	23.1%
Tariffs not reflecting costs	5.1	17.9	28.2%	43.6%	5.1 %

Source: Author's own calculations

5.5.5 THE IMPACT OF TECHNICAL ISSUES ON WATER SUPPLY DISRUPTIONS

The NWRS (2013) notes that water loss in municipalities is normally greater than 37% with the situation much worse in numerous irrigation and municipal supply schemes as the predicted losses shoot up to 60 per cent. This sub-section analyses the technical issues that contribute to water services delivery interruptions.

Roughly 88% of the respondents "agree" and "strongly agree" that water loss due to poor infrastructure increases the probability of having disruptions. Only 25% agree that poor water quality cause disruptions in their municipalities. Precisely 45% agree that poor effluent discharged in water resources causes disruptions in their municipalities. Finally, 57.5% of the respondents agree that lack of good water treating technologies increases the probability of having disruptions in the supply of water.

Table 5.5.5: Technical issues at local government

Item	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
Poor water quality	15.0%	52.5%	7.5%	22.5%	2.5%
Poor effluent Discharged into the Water resources	17.5%	20.0%	17.5%	32.5%	12.5%
Lack of good water treating technologies	7.5%	27.5%	7.5%	42.5%	15.0%

Water loss due infrastructure	5.0%	5.0%	2.5%	37.5%	50.0%

Source: Author's own calculations

5.5.6 THE IMPACT OF WATER DEMAND ON WATER DISRUPTIONS

South Africa's Gauteng Province's growth in demand must be met with $1.5 billion investments on waste water management plants and a $2.7 billion investment on water expansion schemes (Ginster *et al.,* 2013). In addition, irrigated agriculture is the largest user of water in South Africa. The agricultural sector accounts for about 60% of water use in South Africa (NWRS 2013). With this reality in mine, the sub-section analyses the perceptions of municipal officials regarding water demand from different consumers.

Table 5.3.6 displays that, only 35% agree that the amount of water used by the commercial farmers contributes to an increase in the probability of disruptions in water supply while 45% disagree. Finally, 85% of the respondents agree that water demand from households and industries it is a major causal factor to the disruptions of water supply in the Free State.

Table 5.5.6: Water demand situations in the Free State Municipalities

Item	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
The amount of water use by commercial farmers	15,0%	30,0%	20,0%	27,5%	7,5%
Water demand from households and industries	2,5%	10,0%	2,5%	45,0%	40,0%

Source: Author's own calculations

5.5.7 PERCEPTIONS ON THE NATURAL RESOURCES CHALLENGES IN LOCAL GOVERNMENT

According to Butler et al (2006), water shortage is not wholly natural as it is also caused by the low levels of investment in water and lack of capacity to manage the growing demand. Failure to mitigate water scarcity limits the use of other factors of production such as labour, capital and entrepreneurship (Meyer, 2007). This section, therefore, assesses the perceptions of municipal officials with regard to ground water, surface water and average rainfall.

Table 5.3.6 below demonstrates the information about perceptions on the natural resources concern in municipalities. Firstly, 52.5% of the respondents agree that ground water resources

are a major challenge in the municipalities. Secondly, 60% agree that surface water is a concern while 80% mentioned that average rain fall was a challenge as they may be considering an occurrence of a drought.

Table 5.5.7: Information on the natural resources concern

Item	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
Ground water	7.5%	22.5%	17.5%	42.5%	10.0%
Surface Water	2.5%	20.0%	17.5%	40.0%	20.0%
Average rain fall	2.5%	7.5%	10.0%	35.0%	45.0%

Source: Author's own calculations

5.5.8 PERCEPTIONS ON VARIOUS SPECIFIC SKILLS SHORTAGES CHALLENGES IN LOCAL GOVERNMENT

There is lack of human capital and skills which is largely caused by the reluctance of skilled people to work in small municipalities (Ginster et al., 2013). The South African National Treasury (2011) found that the major challenge being faced in the electricity and water services sector is that of skills, with the number of engineers having fallen dramatically since 1994. As a result, this sub-section analyses the perceptions on engineers, process controllers and leadership skills shortages.

Table 5.5.8 below demonstrates the perceptions on the shortages of different skills in municipalities. Concerning engineers, 87.5% agree that that there is a shortage of engineers in their municipalities. With regard to Process Controllers, 90% agree that they have a shortage of process controllers. Finally, 75% agree the leadership is a problem in the municipalities.

Table 5.5.8: Different skill shortages

Item	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
Engineers	2.5%	7.5%	2.5%	52.5%	35.0%
Process Controllers	2.5%	7.5%	0.0%	75.0%	15.0%
Leadership skills	0.0%	15.0%	10.0%	57.5%	17.5%

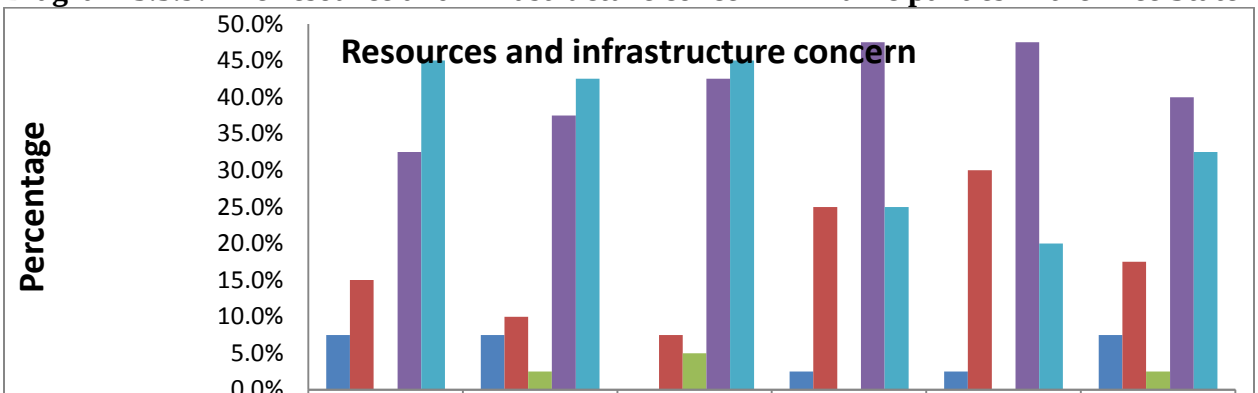
Source: Author's own calculations

5.5.9 RESOURCES AND INFRASTRUCTURE CONCERNS IN LOCAL GOVERNMENT

The subsections examine the perceptions of municipal officials with regard to resources and infrastructure such as dams, rivers, pipelines, reservoirs, water treatment plants and boreholes.

Table 5.9.9 below shows that the majority of the respondents identified dams, rivers and pipelines as major concerns in their municipalities. According to the NWRS (2013), water supply shortfalls are normally caused by poor water supply management. Water management problems include lack of metering, enormous wastage of water, high per capita use, free water actuality delivered even to the rich, lack of proper maintenance, poor cost recovery, lack of skilled operators and a low technical competency.

Diagram 5.5.9: The resource and infrastructure concern in municipalities in the Free State



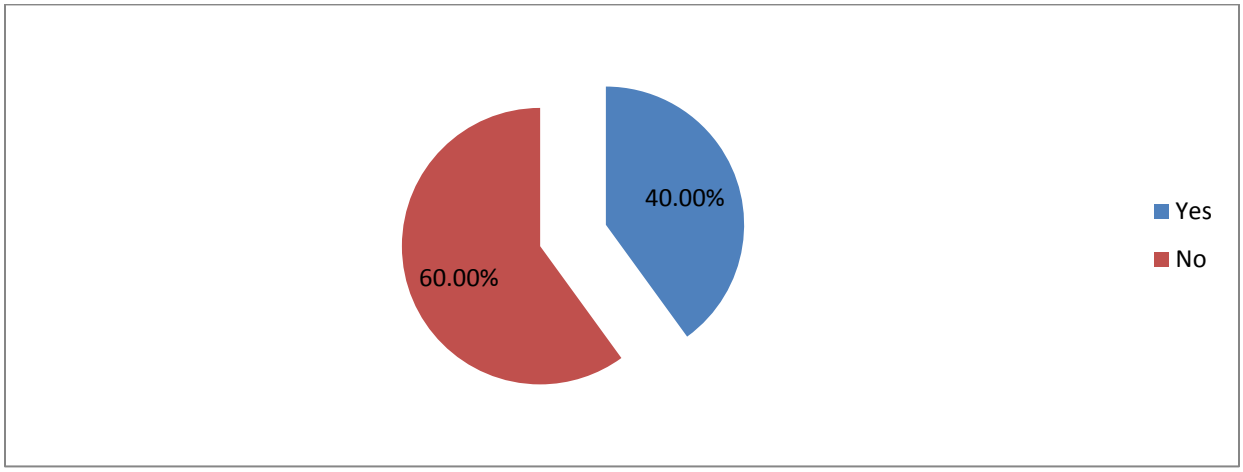
	Dams	Rivers	Reticalations (pipelines)	Reservoirs	Water Treatment Plant	Boreholes
Not a concern at all	7.5%	7.5%	0.0%	2.5%	2.5%	7.5%
Not a concern	15.0%	10.0%	7.5%	25.0%	30.0%	17.5%
Not Sure	0.0%	2.5%	5.0%	0.0%	0.0%	2.5%
Minor concern	32.5%	37.5%	42.5%	47.5%	47.5%	40.0%
Major concern	45.0%	42.5%	45.0%	25.0%	20.0%	32.5%

Source: Author's own calculations

5.5.10 THE FREQUENCY OF DISRUPTIONS ON POOR VERSUS RICH HOUSEHOLDS

Generally, most respondents felt that the frequency of disruptions in influenced more by where the area is located than whether the area is poor or rich. Upper areas were perceived to have more disruptions than lower areas in municipalities. Diagram 5.3.10 shows that precisely 60 per cent of respondents do not agree that poor townships are experiencing more disruptions than rich townships.

Diagram 5.5.10 Disruption on Poor Townships



Source: Author's own calculations

5.6 CONCLUSION

Poor maintenance, ageing infrastructure, amount of water in dams and low income households were identified in the logistic model as being the statistically significant and thus impacting negatively on the frequency of water disruptions among the municipalities. In addition, the survey indicates that 97.5% of the interview respondents agree that ageing infrastructure increases the probability of having disruptions in water supply. This perception confirms the results of the logistic regression model that mentioned ageing infrastructure as one of the factors that is linked to negatively affecting the provision of water services in the Free State Province. Another factor that confirmed the findings of the model is the of the proportion of poor

households, where 82.1% of the respondents assert that the frequency of water disruptions is high in communities with a higher proportion of poor households.

With regards to strike activity as a cause of service delivery disruptions, it was noted that the majority view of 69.2% of the respondents perceives strike activity as not to a cause while only 15.4% agree that strikes cause disruptions. One may expect strikes to increase disruptions in water supply as strikes tend to be generally violent most of the time in South Africa.

Skills shortage is perceived to be a serious issue leading to water supply disruptions as confirmed by 82% of the respondents who held that view. The shortage of engineers, process controllers and leadership skills was rated high by the respondents as a challenge faced by municipalities in the Free State.

There were more respondents who disagreed with the view that the amount of water used by commercial farmers led to disruptions of supplies in municipalities. In addition, water demand from households and industries is a challenge in municipalities as 85% of the respondents agree that it is a factor that causes disruption in water supply in the Free State. Finally, 88% of the respondents agree that water loss due to poor infrastructure increases the probability of supply disruptions.

On finance related issues, nearly 95 per cent respondents were of the view that non-payment causes frequent disruptions and approximately 92% thought that revenue raising capacity is an issue that leads to disruptions in water services delivery. Finally, 77% of the respondents agree that consumer debt increases the likelihood of having disruptions in water services delivery.

CHAPTER SIX: SUMMARY, RECOMMENDATIONS AND CONCLUSION

6.1 INTRODUCTION

This chapter provides an overall summary of the study followed by the main findings drawn from the logistic regression model that analyses archival data and the survey questionnaire that assesses the perceptions of senior municipal officials involved in the water division of Free State towns.

6.2 SUMMARY OF THE STUDY

The main objective of the study was to investigate the factors that increase the probability of water supply disruptions in the Free State Province using archival data. The second objective was to assess the perceptions of senior municipality officials involved in the water division with regards to the causes of frequent water disruptions, through the use of a survey questionnaire.

The literature review in Chapter 2 revealed that there is a tendency among politicians to favour above ground infrastructure at the expenses of underground infrastructure like water pipelines. In addition, municipalities usually prioritise setting up of new infrastructure at the expense of investments in maintenance or recurrent costs. Politicians are biased towards to services provision where they can provide to one community and exclude other community. According to Heleba (2009), poor maintenance in water infrastructure in South Africa has led to unreliable infrastructure and water supply disruptions. Leakages and illegal water makes the economy to operate below its potential (Schwartz & Johnson, 1992). Any infrastructural deterioration, as noted in the fall of the tourism and accommodation business in Carolina, Mpumalanga after a water contamination case (Tempelhoff et al., 2012), reduces economic growth. Ginster *et al*., (2013) observe that water supply disruptions negatively affect the delivery of healthcare, schools feeding schemes and the sale of houses in Brandfort.

Under such circumstances, Policy Makers can be held accountable easily by people in small municipalities as they have better access to them. This is unlike in large councils where there exists a potential to enjoy economies of scale and yet the potential is not used (Dollery, 2003).

In the post-apartheid era the ANC led democratic government faced the challenge of ensuring that all municipalities develop the requisite capacity to translate available resources into instruments to alleviate poverty, underdevelopment and inequality. Strategic interventions which include public participation, programme management as well as creating conditions for sustainable service delivery and economic development were expected to address the mentioned problems (Mufamadi (2005). Although service delivery was earmarked by government as a critical area of intervention, less than stellar successes were achieved, over the last five years or more many marginalised communities have engaged in service delivery protests and in the 2016 local government elections the ANC led lost a number of municipalities and three metros to the opposition parties. Hence within the context of the Free State Province the study attempted to assess the nature of the challenges in regard to service delivery of water.

6.3 SUMMARY OF THE RESULTS

6.3.1 LOGISTIC REGRESSION RESULTS

The regression logistic equation was used In order to assess the water supply disruption outcomes. The findings of the regression results were as follows:

- A municipality that is plagued by poor maintenance problems has a higher probability of frequent water disruptions. Poor maintenance falls in the domain of weak management systems and is directly linked to the difficulty of holding municipal staff accountable. It is also linked to van Zyl's (2014) observation that less money is allocated for on-going maintenance, a condition that leads to both the deterioration of the infrastructure and poor service delivery.
- Ageing infrastructure was identified as another critical problem affecting a municipality's ability to prevent a rise in the frequency of water disruptions. On the surface this problem might reflect lack of resources, but it could also imply the existence of poor management

systems and the lack of the requisite skills for forward planning and accessing the available funding at central government level or to attract private sector funding through bond issuance for example. Additionally, the existence of infrastructure problems might suggest that the local authorities do not have policies in place to bring in private partners. However, Naidoo (2017) observes that South Africa is better in terms of collective action between the public and the private sector. There is still a need to build trust between the two sectors.

- The level of water in the dams is another critical factor influencing water disruptions. The challenge of low dam levels together with poor maintenance and ageing infrastructure exacerbates the problem. It implies that the local authorities lack the capacity and resources to strategically conserve water through fixing leaks and finding other sources of water such as underground water. Disruptions during low dam levels can also be linked to water restrictions. Low dam levels compel governments to come up with restrictions and these are used to prolong water supply during periods of water shortages and to reduce or stop the usage of water for less critical purposes (Balzer 2016). For example, South Africa, Swaziland, Botswana and Namibia advised their citizens to limit water usage because of low dam levels during the drought that resulted in low dam levels.
- Communities with low income levels appear to be another significant factor that explains the increased frequency of water disruptions. The implication is that when a community becomes poor, owing to a rise in the number of people with low incomes, then there will be rise in the frequency of water disruptions. This is because communities that become poorer might default on their utility bills which in turn affect the services that municipalities provide to those communities and result in a higher frequency of disruptions.

6.3.2 SURVEY RESULTS

The survey results reveal the following factors that were rated high by the interview respondents:

- The survey indicates that 97.5% of the respondents agree that ageing infrastructure increases the probability of having disruption in water supply. This perception confirms

the results of the logistic regression model that show ageing infrastructure as one of the factors that negatively affect the provision of water services in the Free State Province.

- The proportion of poor households had 82.1% of the respondents assert that the frequency of water disruptions is high in communities with a higher proportion of poor households. This perception also confirms the finding of the logistic regression.
- With regard to strike activity as a cause of service delivery disruptions, the majority 69.2% of the respondents surprisingly perceives strike activity as not being a problem, while only 15.4% agree strike cause disruptions. Strikes tend to be violent in South Africa and as such one may expect it to cause disruptions.
- Skills shortage is perceived to be a serious problem leading to water supply disruptions as noted by 82% of the respondents. The shortage of engineers, process controllers and leadership skills was rated high by the respondents as one of the challenges that are faced by municipalities in the Free State.
- More respondents feel the amount of water used by commercial farmers does not lead to disruption in municipalities, however, only 35 were of the view that it leads to disruptions. Water demand from is a challenge in municipalities. 85% of the respondents agree that demand from households and an industry is associated with disruptions in water supply in the Free State. Roughly 88% agree that water loss due to infrastructure increase the probability of having disruptions.
- On finance related issues, nearly 95% of the respondents felt that non-payment is a cause of frequent disruptions while approximately 92% were of the view that revenue raising capacity issues lead to disruptions in water services delivery. Finally, 77 % of the respondents agree that consumer debts f increase the likelihood of disruptions in water services delivery.

6.4 LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

There were a number of limitations to this study and some of the more critical limitations are outlined below:

First, the study could not get reliable data on finance-related issues. Hence, the study did not find a statistically significant relationship via the logistic regression model between lack of revenue collection and disruption outcomes. Pooling data across a number of municipalities from different provinces might lead to the finding valid relationships between variables.

The Logistic regressions generally depend on large sample sizes. However, this study used only 72 observations. Moreover, this study employed cross section data for 2016. Future studies ought to gather data from a number of municipalities from different provinces, over a number of years and thereby pooled and panel data analyses may be conducted.

6.5 RECOMMENDATIONS

The study makes the following recommendations in regard to maintenance.

6.5.1 MAINTANANCE

Municipalities should prioritise the maintenance of infrastructure. Majors and Councillors should be trained about the importance of maintenance in local government and strive at prioritising more the interest of their communities than political gain. As Batley and Mcloughlin (2015) note, politics affects and is affected by the performance of public services. There are more political benefits that can be realised from responding to visible issues and producing visible goods than not visible services such maintenance of infrastructure. When politicians go for personal gain the may ignore services such as maintenance of water infrastructure.

6.5.2 AGEING INFRASTRUCTURE

There is need to improve and maintain ageing infrastructure. Mokonyane (2017) notes working with the private sector may improve service and trust between local government and the private sector with an example of a collaboration that allowed trust being that of Mine Water Coordinating Body in the Mpumalanga Province in South Africa and municipalities. Mine companies and local government partnered to reduce the effects from mining pollution. In addition, initiatives such as Expanded Public Works Programme, Jobs fund and the National Skills Development Strategy increased collaboration between the government and the private sector with regards to the maintenance of infrastructure.

6.5.3 INCREASE REVENUE COLLECTION IN MUNICIPALITIES

Municipalities should be encouraged to widen the revenue collection base to almost all the households. However, according to Hemson, Dube, Mbele, Nnadozie and Ngcobo (2006) poor people cannot afford even the lowest tariffs for cost recovery, which suggests that the poor households should not be forced to participate in cost recovery programs. The researcher's view is that the rich should be encouraged to pay the cost recovery tariff while the poor pay a base tariff way below cost recovery of say R60 a month for a nominal amount of water per household. This may increase revenues for municipalities.

6.5.4 INCREASING SKILLS IN LOCAL GOVERNMENT

The Province ought to offer market related incentives and thereby attract graduates with engineering qualifications to the water divisions of municipalities. Moreover, they should offer bursary incentives for matric students to pursue studies in specialist areas such as hydrology on condition that they will serve local municipalities upon completion of their studies. According to Hogg and Samson (2011), most municipal employees lack skills and this hinders service delivery. Various cases reflect that municipal officials often do not know how to forge strategic associations and involve communities on the widespread spectrum of government-sponsored programmes and tasks in order to improve the life of the poor, hence the need to improve the levels of local government public servants' skills.

6.5.5 MANAGING WATER DEMAND IN MUNICIPALITIES

Municipalities ought to engage in aggressive civic education programmes focusing on water saving measures. They also ought to invest in water source diversification approaches such as sinking boreholes, and encourage farmers to grow water resistant crops**.**

6.6 CONCLUTION

Poor maintenance and ageing infrastructure has been noted as the major cause of water services delivery disruptions. Therefore, there is a need for municipalities to improve their maintenance

programmes and increase the number of households who pay for services as the revenue will be invested in maintenance and replacement of old infrastructure. A consistent and reliable water supply is needed in all municipalities as disruptions have a negative impact on the well-being of households, the economy in general and particularly in the tourism sector which is becoming a significant contributor or GDP, ahead of a traditional sector like mining.

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QUESTIONNAIRE

TOPIC: Identifying the factors that affect the provision of water to households in the Free State Province .

RESEARCHER: Lucky Isaac Lukhele

STUDENT NUMBER: 20001142

DEGREE: Mcom (Economics)

FACULTY: Commerce, Administration and Law

DEPARTMENT: Economics

SUPERVISOR: Dr. I Kaseeram

INSTITUTION:

UNIVERSITY OF ZULULAND

INFORMED CONSENT DECLARATION

(Participant)

Project Title:

Lucky Isaac Lukhele from the Department of Economics, University of Zululand has requested my permission to participate in the above-mentioned research project.

The nature and the purpose of the research project and of this informed consent declaration have been explained to me in a language that I understand.

I am aware that:

1. The purpose of the research project is to assess factors that cause disruption in water supply in the local government

2. The University of Zululand has given ethical clearance to this research project and I have seen/ may request to see the clearance certificate.

3. By participating in this research project I will be contributing towards developing policy recommendations that may benefit municipalities in the Free State, government and all stakeholders concerned particularly in the Free State.

4. I will participate in the project by completing the attached questionnaire without prejudice.

5. My participation is entirely voluntary and should I at any stage wish to withdraw from participating further, I may do so without any negative consequences.

6. I will not be compensated for participating in the research, but my out-of-pocket expenses will be reimbursed.

7. I understand that the foreseeable risks associated with this study are minimal. These risks are similar to those associated the disclosure of work related information to others. The researcher has assured me of confidentiality and anonymity in regard to the dissemination of any information to others. However, I am fully aware that I may decline to answer any question (or all the questions) and that I have a right to withdraw from participating at any time during the interview/ administration of questionnaire.

8. The researcher intends publishing the research results in the form of a dissertation, however, confidentiality and anonymity of records will be maintained and that my name and identity will not be revealed to anyone who has not been involved in the conduct of the research.

9. I will not receive feedback regarding the results obtained during the study.

10. Any further questions that you might have concerning the research or my participation will be answered by Dr. I Kaseeram, Faculty of Commerce, Administration and Law, Economics Department.

    Telephone no: (035) 902 6424
    Email: KaseeramI@unizulu.ac.za

11. By signing this informed consent declaration I am not waiving any legal claims, rights or remedies.
12. A copy of this informed consent declaration will be given to me, and the original will be kept on record.

I have read the above information / confirm that the above information has been explained to me in a language that I understand and I am aware of this document's contents. I have asked all questions that I wished to ask and these have been answered to my satisfaction. I fully understand what is expected of me during the research.

I have not been pressurized in any way and I voluntarily agree to participate in the above mentioned project.

…… ……..

Participant's signature **Date**

INSTRUCTIONS: Respondent Number: ……..

1. Please answer all questions
2. Answer as honestly as possible. YOUR OPINION IS REQUIRED.
3. Please do not change any of your responses afterwards (for instance: do not scratch out or tippex any of your responses).
4. Please use a pen to mark your responses by placing a mark (**X**), in the appropriate numbered column, or by writing down the appropriate information, wherever required.

Your honest answers to these questions will help us understand what is happening in the water services in the Municipality and recommend some policies to improve your livelihood security.

Your answers or responses represent other residents in your area. So, please take your time to answer carefully all questions that apply to you.

Remember that all your answers and or responses are strictly confidential and are not linked with your name in any way. If you need help with any question, please ask the researcher or research assistant to clarify.

Thank you for the generous and valuable contribution of your time and energy.

1. Gender of respondent (Please tick only **one**)

Male	1

Female	2

2. Position in a Municipality

Water Manager	1
Technical Manager	2
Municipal Manager	3
Major	4
Technical officer	
Other	5

3. The following factors lead to disruption in water supply to households in your municipality

Ageing Infrastructure	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Water storage capacity	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Water Quality (colour , taste and smell)	Strongly disagree	Disagree		Agree	Strongly agree
Poor effluent discharged into the water recourses	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Lack of good water treating technologies	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Water loss	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
The amount of water used by commercial farmers	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Institutional arrangement	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Strikes	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Debts from consumers	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Revenue raising capacity problem	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
The number of	Strongly	Disagree	Not	Agree	Strongly agree

poor households	disagree		sure		
The number female headed households	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Lack of water meters	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Non-payment for water services	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Low equitable share grant and conditional grants	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Tariffs not reflecting the costs	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Water demand	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Town development	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Droughts	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Electricity disruption and cable theft	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Shortage of skills	Strongly disagree	Disagree	Not sure	Agree	Strongly agree

4. The following resources are major problem in municipality?

Ground water	Strongly disagree	Disagree	Not sure	agree	strongly agree
Surface water	Strongly disagree	Disagree	Not sure	agree	strongly agree
Average rain fall	Strongly disagree	Disagree	Not sure	agree	strongly agree

5. The concern of resources or infrastructure in your municipality

	Not a concern at all	Not a concern	Not sure	Minor concern	Major concern
Dams					
Rivers					
Reticulations (pipelines)					
Reservoirs					
Water treatment plant					
Boreholes					

6. Who supply bulk water services in the municipality?

Own supply	
Water Board	
Other Water Services Provider	
Combination of a municipality and a water board	

7. Does the municipality supply retail water to all communities under its jurisdiction?

yes	no

8. If no, which areas are supplied by a Water Board or any other Water Services Provider?

_____

_____

_____

9. Does the municipality provide free water

yes	no

10. Does the municipality provide free basic water or a portion of free water to every household?

yes	no

11. If not what types of households receive free water from the municipality?

_____
_____
_____

12. If the municipality supplies free water according to the Indigent Policy. Does the municipality have meters on all households receiving free basic water? And , What happens if a consumer consume for more water than 6 KL allocated based on Indigent Policy for drinking water?

_____
_____
_____

13. How does the municipality ensure that those who benefit from free basic water consume only the subsidized amount of water?

Restrict the flow of water	
Cut water once 6 kl is reached	
Bill an indigent household and demand pay	
Other	

14.

15. Do households who reside in farms included in the indigent register of the municipality?

Yes	no

16. Does the municipality have more 50 percent of households having meters for water?

Yes	no

17. The municipality experience the following skills shortage

Engineers	Strongly disagree	Disagree	Not sure	Agree	strongly agree
Process Controllers	Strongly disagree	Disagree	Not sure	Agree	strongly agree
Leadership Skills	Strongly disagree	Disagree	Not sure	Agree	strongly agree

18. What do you think is the major driver of disruption for water services in your municipality?

_____

_____
_____
_____

19. What do you think should be done to avoid water disruptions in water supply in your municipality?

_____
_____
_____

20. When last did you receive complaints with regard to water supply from communities?

1 to 2 weeks ago	1
3 to 4 weeks ago	2
More than a month ago	3

21. Which areas in your municipality are not normally affected by water interruptions?

_____
_____
_____

22. What community or settlement is experiencing more frequent water supply disruption?

_____
_____
_____

23. Are poor townships experiencing more water services disruptions than rich townships?

Yes	No

24. The municipalities receives complaints from the community as follows

The public complain every hour about water	Strongly disagree	Disagree	Not sure	Agree	strongly agree
Every day people complain about	Strongly disagree	Disagree	Not sure	Agree	strongly agree

water					
The public complaint once after some time	Strongly disagree	Disagree	Not sure	Agree	strongly agree

Thank you for your time

Appendix B: Possible variables associated with the disruption of water supply

Variable	**Symbol**	**Units of measurement**
Dependent Variable Frequency of Disruption	Y	1 or 0
Independent Variables		
poor maintenance	x1	1or 0
water storage capacity	x2	1 or 0
grant disbursement per town	x3	rands
number of low income households	x4	head count
number of households	x5	head count
ageing infrastructure	x6	1 or 0
infrastructure backlogs	x7	1 or 0
quantity of water demanded	x8	(m3/annum)
Litres / capita / day	x9	L per Capita
Piped water inside dwelling	x10	%
Female headed households	x11	1 or 0
quality of effluent discharge	x12	1 or 0
Amount of water in dams	x13	1 or 0
Water loss due to to theft	x14	%
Low Income (as percent of population)	x15	%
informal households on RDP Level as a % of population on water	x16	%
% Total Households Below RDP Sanitation (formal)	x17	%

Appendix B1: used variables associated with the disruption of water supply

Variable	Symbol	Units of measurement
Dependent Variable Frequency of Disruption	Y	1 or 0
Independent Variables		
poor maintenance	x1	1or 0
water storage capacity	x2	1 or 0
grant disbursement per town	x3	rands
number of low income households	x4	head count
ageing infrastructure	x6	1 or 0
quantity of water demanded	x8	(m3/annum)
Piped water inside dwelling	x10	%
Female headed households	x11	1 or 0
quality of effluent discharge	x12	1 or 0
Amount of water in dams	x13	1 or 0
Water loss due to to theft	x14	%
Low Income (as percent of population)	x15	%

Appendix C

Table A: Logistic Regression with all possible causal factors

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-4.077645	5.390338	-0.756473	0.4494
X1	2.222288	1.072949	2.071196	0.0383
X2	-0.923141	0.906406	-1.018464	0.3085
X3	6.93E-09	1.48E-08	0.469354	0.6388
X4	-0.000202	0.000177	-1.139872	0.2543
X6	1.723926	1.114397	1.546958	0.1219
X8	6.66E-08	1.98E-07	0.336475	0.7365
X10	2.401081	2.523053	0.951657	0.3413
X11	1.003505	9.465488	0.106017	0.9156
X12	-0.357617	0.860097	-0.415787	0.6776
X13	-1.785336	0.871414	-2.048780	0.0405
X14	-2.249495	4.853115	-0.463516	0.6430
X15	0.061103	0.035392	1.726445	0.0843

McFadden R-squared	0.272541	Mean dependent var	0.615385
S.D. dependent var	0.491251	S.E. of regression	0.471905
Akaike info criterion	1.469381	Sum squared resid	8.685081
Schwarz criterion	1.957192	Log likelihood	-25.20391
Hannan-Quinn criter.	1.656396	Deviance	50.40782
Restr. deviance	69.29296	Restr. log likelihood	-34.64648
LR statistic	18.88514	Avg. log likelihood	-0.484691
Prob(LR statistic)	0.091338		

Obs with Dep=0	20	Total obs	52
Obs with Dep=1	32		