

**AN INVESTIGATION OF WATER SUPPLY CONSTRAINTS IN GIYANI TOWNSHIP,
GREATER GIYANI LOCAL MUNICIPALITY, MOPANI DISTRICT, LIMPOPO
PROVINCE**

by

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DISSERTATION

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DECLARATION

I declare that an investigation of water supply constraints in Giyani Township, Greater Giyani Local Municipality, Mopani District, Limpopo Province dissertation hereby submitted to the University of Limpopo, for the degree of Master of Science in Geography has not previously been submitted by me for a degree at this or any other university; that it is my work in design and in execution, and that all material contained herein has been duly acknowledged.

Signature..........

02-11-2021

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CHAPTER 1

INTRODUCTION

1.1. Background of the study	1
1.1.1. Availability and accessibility of water.....	2
1.1.2. Water shortage.....	3
1.2. Problem statement	4
1.3. Motivation of the study	5
1.4. Purpose of the study	5
1.4.1. Aim of the study.....	5
1.4.2. Objectives.....	5
1.4.3. The main research questions for the study.....	6
1.5. Study Area.....	6
1.6. Scientific contribution	7
1.7. Ethical considerations	7
1.8. Definition of concepts	8
1.8.1. Community.....	8
1.8.2. Constraint.....	8
1.8.3. District Municipality.....	8
1.8.4. Integrated Development Plan.....	8
1.8.5. Local Municipality.....	8
1.8.6. Service delivery.....	9

1.8.7. Water	9
1.8.8. Water service authority.....	9
1.8.9. Water supply	9
1.9. Limitations to the study.....	9
1.10. Chapter outline.....	10
1.11. Summary of chapter.....	11

CHAPTER 2

LITERATURE REVIEW

2.1. Introduction.....	12
2.2. Water as a natural resource.....	12
2.3. Uses of water.....	13
2.4. Geographical availability and accessibility of water.....	15
2.5. Quality of water.....	20
2.6. Water scarcity.....	23
2.7. Impacts of water shortage.....	26
2.8. Factors that contribute to water supply constraints.....	28
2.8.1. Population growth and urbanisation.....	28
2.8.2. Vandalism of water infrastructure	29
2.8.3. Ageing infrastructure.....	30
2.8.4. Shortage of skilled staff in the water sector.....	31
2.8.5. Financial management capacity.....	33
2.9. Intervention strategies for water shortage	35
2.10. Community participation	38

2.11. Role of Government in water provision	43
2.12. Legal framework for water services in South Africa	47
2.12.1. The Constitution of South Africa.....	47
2.12.2. The Free Basic Water Policy.....	48
2.12.3. The Water Services Act 108 of 1997.....	49
2.12.4. The National Water Act 36 of 1998.....	49
2.13. Summary of chapter	50

CHAPTER 3

RESEARCH METHODOLOGY

3.1. Introduction	52
3.2. Research design	52
3.3. Sampling	53
3.3.1. Sampling frame.....	53
3.3.2. Sample size.....	53
3.3.3. Sampling techniques.....	53
3.4. Data collection methods	54
3.4.1. Secondary data.....	54
3.4.2. Primary data.....	54
3.4.2.1. Questionnaires.....	55
3.4.2.2. Key Informant Interviews.....	55
3.4.2.3. Observation.....	55
3.5. Data analysis and presentation of results	56
3.6. Summary of the chapter	56

CHAPTER 4

PRESENTATION AND DISCUSSION OF RESULTS

4.1. Introduction	58
4.2. Demographic characteristics of respondents in Giyani Township	58
4.2.1. Age of respondents in Giyani Township	58
4.2.2. Gender of the respondents in Giyani Township	59
4.2.3. Educational level of the respondents in Giyani Township	60
4.2.4. Occupational level of respondents in Giyani Township	61
4.2.5. Households' monthly income of residents in Giyani Township	62
4.2.6. Household sizes in Giyani Township	63
4.2.7. Participants' period of stay in Giyani Township	65
4.3. Water availability and accessibility in Giyani Township	65
4.3.1. Sources of water in Giyani Township	66
4.3.2 Uses of water in Giyani Township	67
4.3.3. Frequency of getting water in Giyani Township	68
4.3.4. Piped water metering in Giyani Township	69
4.3.5. Average water consumption per day per household in Giyani Township	71
4.4. Concerns and constraints of water availability in Giyani Township	73
4.4.1. Seasonal water shortage in Giyani Township	73
4.4.2. Other causes of water shortage in Giyani Township	75
4.4.3. Impact of water shortage in Giyani Township	77

4.4.4. Reporting of pipe bursts in Giyani Township.....	77
4.4.5. Notification of water cut-offs in Giyani Township.....	78
4.4.6. Water Service delivery in Giyani Township.....	79
4.5. Challenges encountered by the authorities in the water sector of Giyani Township	82
4.5.1. The responses of the key informants' interview.....	82
4.5.1.1. Plant superintendent of Greater Giyani Local Municipality.....	82
4.5.1.2. Process controller of Giyani Local Municipality water supply services.....	83
4.5.1.3. Head of water reticulation services and maintenance division in Giyani Local Municipality.....	84
4.5.1.4. Greater Giyani Local Municipality representative.....	84
4.7. Summary of the chapter.....	85

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction.....	86
5.2. Summary of the results.....	86
5.2.1. Demographic characteristics.....	87
5.2.2. Water availability and accessibility.....	87
5.2.3. Concerns and constraints for water availability in Giyani Township.....	88
5.2.4. Challenges encountered by the authorities in the water sector.....	89
5.3. Conclusions.....	89
5.4. Recommendations.....	91
5.5. Conclusion.....	92

References	94
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APPENDICES	118
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Appendix 1: Turfloop Research Ethics Committee Clearance Certificate (TREC)....	118
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Appendix 2: Observation checklist	119
-----------------------------------------	-----

Appendix 3 (a): Questionnaire.....	120
------------------------------------	-----

Appendix 3(b): Translated questionnaire.....	125
----------------------------------------------	-----

Appendix 4: Letter of consent.....	130
------------------------------------	-----

Appendix 5: Consent to participate in this study	131
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LIST OF FIGURES

Figure 1.1: Map of the study area.....	7
Figure 2.1: Communication model within the water sector.....	40
Figure 4.1: Age of respondents in Giyani Township.....	59
Figure 4.2: Educational level of respondents in Giyani Township.....	61
Figure 4.3: Occupational level of respondents in Giyani Township.....	62
Figure 4.4: Households' monthly income of Giyani Township residents.....	63
Figure 4.5: Household sizes in Giyani Township.....	63
Figure 4.6: Participants' period of stay in Giyani Township.....	65
Figure 4.7: Frequency of getting water in Giyani Township.....	69
Figure 4.8: Monthly payment of water bills in Giyani Township.....	70
Figure 9: Average water consumption per day per household in Giyani Township	72
Figure 4.10: Seasons of water shortage in Giyani Township.....	74
Figure 4.11: Methods of reporting pipe bursts in Giyani Township.....	78
Figure 4.12: Rating of water service delivery in Giyani Township.....	81

LIST OF TABLES

Table 2.1: Major categories of water pollution.....	23
Table 2.2: Current (1995) and predicted (2025) population size and water scarcity.....	25
Table 4.1: Association between gender and water use in Giyani Township	60
Table 4.2: Household size and water consumption per day in Giyani Township.....	64
Table 4.3: Association between household income and type of water source	67
Table 4.4: Association between water consumption and water use in Giyani Township	68
Table 4.5: Association between water usage and amount paid	71
Table 4.6: Association between frequency of water supply and seasonal water shortage.....	73
Table 4.7: Association between service delivery and water frequency in Giyani Township	80
Table 4.8: Key informants interviewed	82

LIST OF ACRONYMS

- CDM = Capricorn District Municipality
- DEA = Department of Environmental Affairs
- DWAF = Department of Water Affairs and Forestry
- DWS = Department of Water and Sanitation
- FAO = Food and Agricultural Organisation
- FBW = Free Basic Water
- GDP = Gross Domestic Product
- IDP = Integrated Development plan
- IPCC = Intergovernmental Panel on Climate Change
- NDP = National Development Plan
- NEPAD = New Partnership for Africa's Development
- RDP = Reconstruction Development Plan
- RSA = Republic of South Africa
- SADC = Southern Development Community
- SANS = South African National Standards
- SDG = Sustainable Development Goals
- SPSS = Statistical Package for Social Science
- UN = United Nations

UNDP = United Nations Development Programme

UNEP = United Nations Environment Programme

UNESCO= United Nations Educational, Scientific and Cultural Organisation

UNICEF= United Nations International Children's Emergency Fund

VUT = Vaal University of Technology

WDM = Water Demand Management

WHO = World Health Organisation

WSA = Water Service Authority

WSDP = Water Service Development Plan

WSSD = World Summit on Sustainable Development

ABSTRACT

In South Africa, inadequate water supply is currently a national crisis hence, referred to as a water stressed country. The study's aim was to assess water supply constraints in Giyani Township of the Greater Giyani Local Municipality that falls under the Mopani District Municipality. The Constitution of the country recognises water as a constitutional right. However, many households in Giyani Township do not receive regular water supply. In some communities, water infrastructure is available but not frequently maintained and that led to irregularity in water supply. The study used qualitative and quantitative research approaches. Self-administered structured questionnaire that consisted of open-ended and close-ended questions helped to collect primary data from the 382 sampled respondents of Giyani Township. Key Informants Interview (interview of people who are authorities responsible for water supply services) supplied information with regard to water delivery services in Giyani Township. Observation method assisted in the evaluation of the condition of the water supply infrastructures as well as the availability of water on a daily basis. Findings of the study indicated that most residents relied on piped water from Giyani Local Municipality, although water was not always readily available from the municipality. Incorrect billing for water services and delays in completion of water relief projects in addition to natural causes and lack of skilled workers were some of the causes that affected the regular supply of water in the township. The study concluded that Greater Giyani Local Municipality experienced a problem of water service delivery that impact negatively on communities and development as a whole. The study recommended that the community should voice out grievances about the irregular water supply and request for further clarifications from the municipality during community meetings..

Keywords: Water, water constraints, water supply, Greater Giyani Local Municipality.

CHAPTER 1

INTRODUCTION

1.1. Background of the study

Water is one of the most important natural resources that sustains life on earth. It covers two-thirds of the earth's surface (Subramanian, 2018). Du Plessis (2017) pointed out that although water is one of the most widely distributed resources across the world's surface, its distribution and availability across the globe is uneven and thus becomes an increasingly major concern. Gad (2017) considered water as a scarce resource owing to the finite nature of freshwater. This is due to among other things, the ever-increasing demand for water resulting from high human population growth, emergence of newly industrial economies, increase in pressures of sectorial and international competition. Bieler (2017), asserts that access to safe water is a fundamental need and a basic human right.

Access to safe water is essential to sustain life and crucial to ensure a healthy and dignified human existence (Harmancioglu, 2017). An improved water access is determined by the usage of good quality drinking water sources by households (Antunes & Martins, 2020). However, UN Water (2013) found that there are about 783 million people across the world, who do not have access to safe drinking water. Africa among other continents, has the lowest total water supply coverage whereby only 62% of the population has access to improved water supply. The situation is likely to be worse in rural areas where water coverage could be estimated around 47% (Abou Zaki *et al.*, 2018). It therefore, suggests that in most cases, the water supply depends on the capacity of the facility installed for its withdrawal.

Water supply is inadequate in South Africa; hence it is highlighted as a national crisis. Only a narrow region along the southeastern coastline receives good rainfall (Phakula *et al.*, 2018). Water has become one of the major constraints to development in South Africa as the country receives the average annual rainfall of less than 500mm (Bond & Stein,

2017). As much as the government might attempt and portray the idea of some improvements being realised in provision of water and sanitation services; Onyenankeya *et al.* (2018) observed that there are still communities that need urgent intervention especially in the provinces of Limpopo, North West, Eastern Cape and Mpumalanga. Many municipalities are still behind with programmes of water management within their jurisdictions and with increased urbanisation and rapid population growth, water demand has increased as well. Meissner *et al.* (2018) highlighted that the unequal distribution in water provision and sanitation services in South Africa are associated with the apartheid era. In Limpopo province, stressed surface water resources is a reality. As a result, majority of the rural areas rely on groundwater resources since they contribute approximately 40% towards water supply (Limpopo Environmental Outlook Report, 2016). An increased population in Giyani municipality in the Limpopo province has been observed. The population increased from 218 752 in 1996 to 240 728 in 2001 and was recorded as 2 444 217 in 2011 (Statistics South Africa, 2011). The increased population on one hand exerted greater demand for water; thereby putting considerable pressure on the available water supply system. The infrastructure on the other hand, was not only responsible for supplying water to Giyani township alone, but also to Giyani local municipality as a whole. Furthermore, it was established from the Department of Water and Sanitation's remarks that the infrastructure seemed to have outlived its life span of 30 years by 10 years more (DWS, 2014).

1.1.1. *Availability and accessibility of water*

Poor water availability and accessibility are pressing problems in developing countries in Africa. In many countries, poor water availability and accessibility are mainly attributed to inadequate quantities of water for human and environmental uses (Smiley & Stoler, 2020). Moreover, availability and accessibility of safe water are also perceived to be pivotal for the world's sustainability without which, poverty eradication and promotion of good health leading to agricultural and economic prosperity cannot be realised (Mabhaudhi *et al.*, 2019). From a global perspective, access to water supply and sanitation services are considered common difficulties experienced to the extent that

access to household water supplies is equally proportionated to a family's health and social dignity.

On average, about 35% of the urban population and 5% of the rural population in Sub-Saharan Africa have access to domestic water supply from piped water into the houses or yards. However, hand, more than half of the population in the rural areas and less than one fifth of the urban population lack access to treated water sources for consumption and sanitation (Emenike, *et al.*, 2017). The Food and Agricultural Organisation (FAO) of the UN as cited by the Limpopo Environmental Outlook Report (2016) stated that the rainfall pattern within Limpopo province is varied, with the northern portion classified as arid, receiving a rainfall of only 201-400mm per year. The majority of the province is semi-arid, receiving 401-600mm of rain per year. Greater Giyani municipal area is characterised by low summer rainfalls of 200-400mm of rain per year with water sources restricted to surface and underground. The major surface water sources are the Middle Letaba Dam fed by Middle Letaba River, the Nsami Dam mainly fed by Nsami River, Koedoes and Brandboontjies rivers which are non-perennial (Greater Giyani Local Municipality IDP, 2017/2018).

Lack of safe drinking water and basic sanitation impose a heavy health burden on children, women and the poor. Long-term physical damages result from carrying heavy weights of water while travelling long distances to and from homes. Poor availability and accessibility of water aggravates poverty, poor school attendance, and slows down overall development (Dinka, 2018).

1.1.2. Water shortage

In many regions of the world more than 2.4 billion people, live in water-stressed countries (Kay & Franco, 2019). In many developing countries, clean water tend to be in short supply. This is because people are heavily depended on traditional water sources such as rivers, dams, lakes and aquifers for drinking water and other essential community needs. People's lives are put to risk because these sources are heavily contaminated in most cases (Omotola *et al.*, 2020). Okhravi *et al.* (2019) affirms that shortage of water sometimes forces people to use unsafe water for drinking and for other domestic

purposes. In China, nearly two-thirds of the country's largest cities have no wastewater treatment facilities (Li *et al.*, 2019). The shifts in rainfall occurrence add to the shortage of water through droughts and floods as observed by the Intergovernmental Climate Change (IPCC) and Stern Review (Miara *et al.*, 2017). Meteorological drivers of drought often cause subsequent hydrological effects such as reduced runoffs of catchments, river flows, and lake levels that may also result in significant changes in water quality (Mosley, 2015). South Africa experienced drought between 2014 and 2015, and it had a devastating or negative impact on the country's economy that was already constrained by a lack of sufficient and safe water supplies. It has directly affected agricultural production, commercial opportunities as well as manufacturing capacity (Barnes, 2016).

1.2 Problem statement

Safe drinking water, sanitation and good hygiene are not only fundamental to health, survival only, but also important for growth and development (Kløve *et al.*, 2017). Provision of sufficient water in terms quality and quantity is proven to be a challenge in South Africa. Verlicchi & Grillini (2020) evidenced that effective provision of drinking water and sanitation services are two of the major challenges the South African public service sector have been faced with since the dawn of the country's multiracial democratic governance in 1994. DWAF (2002) established a White Paper, a policy on water services, which defines basic water supply as the provision of appropriate water with a minimum quantity of 25 liters of potable water per person per day or 6 000 liters per household per month within 200 meters of a household. This is sufficient for cooking and drinking. Bisung & Elliott (2018) maintained that the laudability of this achievement becomes debatable when confronted with the local reality of unreliable water supplies. From what is alluded, the community of Giyani Township has a challenge of irregular water supply, as many households do not receive a regular supply of water. This observation has therefore, called for an investigation on the causes of water supply constraints in Giyani Township.

1.3 Motivation for the study

Water is a finite resource with an immeasurable economic value and one for which competition is likely to increase as the economy grows (Valhondo & Carrera, 2019). The major societal water use in both urban and rural areas is domestic. Safe domestic water supply meets two basic water uses which are basic human physiological water requirements such as adequate hydration, human hygienic conditions and crucial for people's health (Adams *et al.*, 2019). Therefore, it needs to be readily available and accessible to everyone. In addition, water is essential in almost all production such as agriculture, industry, energy, and transport. On the other hand, water can also be associated with suffering, devastation, destruction and disaster in case of droughts and floods, as well as contamination.

The basic human rights such as the right to life, the right to education, and the right to food cannot be fully realised unless people have access to potable water and basic sanitation (Edokpayi *et al.*, 2020). The basic needs approach describes water as a natural resource utilised on a daily basis. Greater Giyani Local Municipality Integrated Development Plan (IDP, 2016/2017) highlighted that it provides about 6 kiloliters of free basic water to all households with pipe water and boreholes to augment the supply. This study is guided by the man-environment theory that emphasises the interaction between humans and the environment, since water is a natural resource that is inseparable from the environment.

1.4. Purpose of the study

1.4.1. Aim of the study

The aim of the study is to assess water supply constraints in Giyani Township of the Greater Giyani Local Municipality.

1.4.2. Objectives

The objectives of the study are to:

- I. Examine availability and accessibility of water in Giyani Township.

- II. Evaluate concerns and constraints with regard to water supply in Giyani Township.
- III. Determine challenges encountered by authorities that work in the water sector of Giyani Township.
- IV. Suggest solutions for water constraints in Giyani Township of the Greater Giyani Local Municipality

1.4.3. The main research questions for the study are:

- i. What are the causes of water supply constraints in Giyani Township?
- ii. What are the effects of the water supply constraints?
- iii. How to solve the water supply constraints in Giyani Township?

1.5. Study Area

Giyani Township (Figure 1.1) is located in the Greater Giyani Local Municipality under the jurisdiction of Mopani District Municipality. The coordinates of Giyani Township are 23.32°South and 30.72° East. The township experiences very hot summer days ($\pm 36^{\circ}$ C) and mild, frost-free winters, with an average maximum winter temperatures of 22° C. The township receives about 421mm of rain per year, with most rainfall occurring mainly during mid-summer (Greater Giyani Municipality IDP, 2016/2017). The major surface water sources are the Middle Letaba River and Nsami dam on the Nsami River. According to the Greater Giyani Municipality IDP (2016/2017), the population of the township is 34 692. The township is divided into three wards namely ward 11 (sections E & D1), ward 12 (section A) and ward 13 (sections D2 & F).

Key sectors of the local economy are manufacturing, trade, catering, government, finance, transport, communications and agriculture. The labour force consists of skilled and semi-skilled people and also a large percentage of unskilled people. However, for the purpose of this study, the residence's economic background is not a prerequisite for participation. It is merely considered for the understanding of affordability given the number of household members and their water usage.

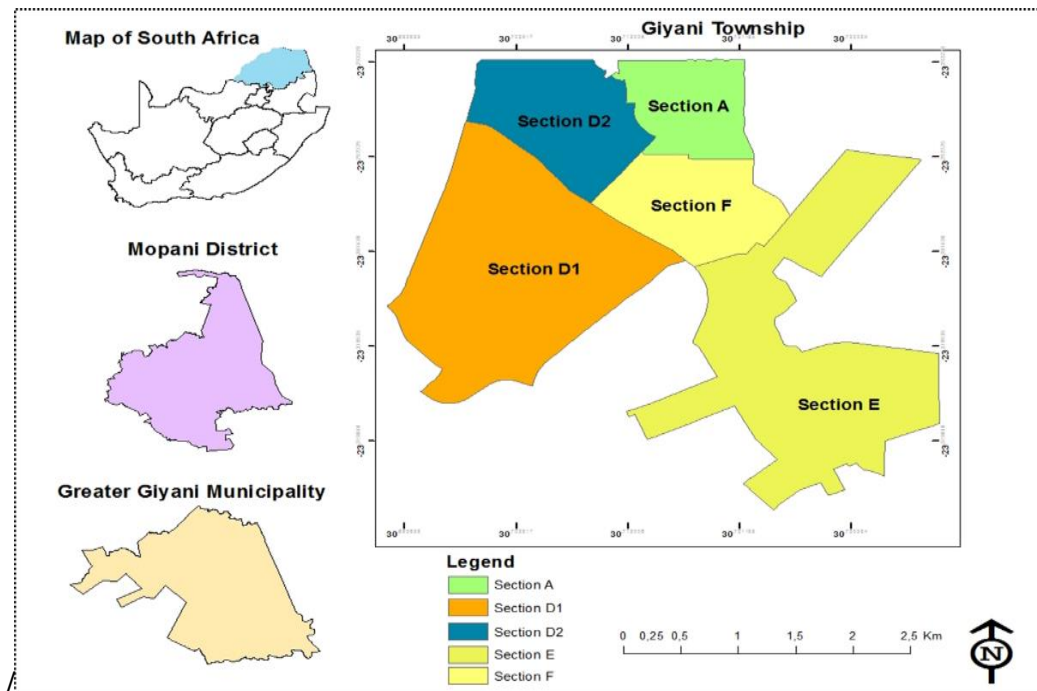


Figure 1.1: Map of the study area (Thamaga, 2018).

1.6. Scientific contribution

The findings of the study will help broaden the understanding of existing knowledge about water service delivery of municipalities. The study will serve as a point of reference for other research conducted on water service delivery. The results of the study will be useful to the Greater Giyani Local Municipality in taking informed decisions related to future water supply. From this study, the community of Giyani township will obtain guidance on water conservation strategies and the economic water usage. The study will also help inform the DWS on how to improve water service delivery challenges through a close cooperation between local municipalities and communities. Policy makers in government, specifically those who deal with water service provision, may use the findings of the study to evaluate the existing by-laws on water provision.

1.7. Ethical considerations

The researcher obtained ethical clearance certificate (2018) from the University of Limpopo Teaching and Research Ethics Committee (TREC). Written permission from the Greater Giyani Local Municipality to conduct the research study in Giyani Township was

obtained. All information about the research was disclosed to the respondents so that they participate on an informed consent. Questions asked by the respondents were clarified and answered. Respondents were made aware that participation in the study was voluntary and that the participants are free to withdraw at any time that they feel like. The respondents' rights were not violated at any given time during their participation and their anonymity was guaranteed. The respondents were also ensured that information provided will be treated confidentially and that there will be no violation of their privacy.

1.8. Definition of concepts

The following are key concepts defined within the context of the study:

1.8.1. Community

Community is a body of people with common rights, privileges or interests, or occupying the same area under the same laws and regulations (Cobigo *et al.*, 2016).

1.8.2. Constraint

Constraint refers to a limiting factor for site selection to locate water supply infrastructure that includes human settlements and technical or physical factors such as mountains, lakes and rivers (Mishra & Moktan, 2019).

1.8.3. District municipality

District Municipality is in Section 155 (1) (c) of the Constitution referred to as an area that has municipal legislative and executive authority over an area that includes more than one municipality. In this study district municipality refers to Mopani District Municipality (Monashane, 2011).

1.8.4. Integrated Development Plan

Integrated Development Plan (IDP) is an institutionalised mechanism for municipalities to perform their responsibilities (Maphunye & Mafunisa, 2008).

1.8.5. Local municipality

According to Section 155 (1) (b) of the Constitution, a local municipality an area in which a municipality shares its municipal executive and legislative authority in its area with a District Municipality within whose area it falls. In this study, local municipality refers to Giyani Local Municipality (Department of Provincial and Local Government, 2001).

1.8.6. Service delivery

Service delivery refers to the municipality's ability to meet the basic requirements of the community such as provision of water, electricity and sanitation (Provan & Milward, 2009).

1.8 .7. Water

Water is an essential clear, pellucid, transparent liquid used daily for survival, as an everyday item and is obtained from sources such as streams, lakes, oceans and rain (Netshipale, 2016).

1.8.8. Water service authority

A water service authority is any municipality that has the executive authority to provide water services within its area of jurisdiction in terms of the Municipal Structures Act 118 of 1998 (Mnisi, 2011).

1.8.9. Water supply

DWAF (1994) defined water supply as a number of liters needed per person daily, which is 25 liters per person daily and it is considered a minimum required for direct consumption, preparation of food and personal hygiene.

1.9. Limitations to the study

The following were some of the limitations to the study:

Some respondents requested consultation through appointments, and in some instances, the participants would say they have important tasks to perform. As a result, the researcher had to reschedule and requested for another appropriate time and date for participation.

Other respondents were not comfortable with some of the questions despite the guaranteed anonymity. They felt that they would be betraying the government by

participating in the study. The researcher had therefore, to give clarification again to make the respondents understand that the information needed was only for academic purposes.

1.10. Chapter outline

Chapter 1

This chapter contains a description of the background to the research study, statement of the problem, motivation for the study, purpose of the study through aim and objectives, scientific contribution, ethical considerations, definitions of key concepts and limitations to the study

Chapter 2

Chapter 2 reviews available literature that relates to water supply constraints.

The literature review helps to show which areas of water supply constraints have been explored and what gaps are there to be closed. The literature also helps to contextualise the topic under study.

Chapter 3

This chapter discusses methodology on collection of data and the analysis thereof. Through the methodology, information obtained from the participants help to answer the problem in question. Each topic has its suitable research method.

Chapter 4

Chapter 4 focuses on data analyses, presentation, and discussion of results. In this chapter, the collected data is analysed. Each data has its own method of analysis to give desired results. The results are presented in such a way that they are interpreted to give more meaning of the problem under study.

Chapter 5

This chapter summarises the research results and draws conclusions on the results as well as making recommendations for future research studies regarding water supply services.

1.11. Summary of chapter

This chapter covered the background of the study on topics such as water availability and accessibility and water shortage. The problem statement, motivation and purpose of the

study and the research questions were discussed. Scientific contribution of the study to the water sector was highlighted and the ethical considerations were outlined. Definitions of key concepts of the study were defined and limitations to the study were briefly discussed. The chapter that follows provides a review of literature based on the challenges that contribute to water supply constraints.

CHAPTER 2

LITERATURE REVIEW

2.1. Introduction

This chapter presents an overview of literature that relates to issues of water service delivery. The literature explores water as a natural resource, its uses, availability and accessibility, and scarcity. Factors affecting water accessibility, quality of water and water supply constraints and impacts of water shortage are discussed. Some factors which are possible contributors to water supply constraints are discussed, the importance of engaging communities in matters of community water projects are outlined including the role of legislature on provision of water is also discussed.

It is well established through literature that water is a deciding factor for human existence, and that it is one natural resource that links everyone and everything directly or indirectly. According to The extent at which people obtain water for their survival is dependent on factors such as climate, and soil among others. These factors also determine the amount of water received and stored for usage, with whichever available infrastructure as well as the number of people among which is distributed Trambly *et al.* (2018).

2.2. Water as a natural resource

Water is a crucial natural resource for survival on earth and is the main source of life without which no organism can survive. Water resources in South Africa are comprised of 77% surface water, 14% return flows and 9% groundwater (Colvin *et al.*,2016). More than 97.5% of the water that is on planet earth is sea water, more than 1.75% is locked in ice-caps and glaciers, and more than 98% of the remaining 0.75% is groundwater which lies far deep under the surface (Dinka, 2018). Surface water from rivers, lakes, and wetlands, is naturally replenished by precipitation and lost through evaporation, transpiration, and discharge into oceans and sub-surface seepage. Groundwater is fresh water located in the pore spaces of soil and rocks. Groundwater is of extensive use in

arid areas where surface water is inadequate. Masocha *et al.* (2018) argued that about 30% of the Earth's freshwater is groundwater, while only about 1% of it is easily accessible for human use in lakes, rivers, and shallow aquifers. This therefore proves beyond doubt that water is a limited natural resource and cannot be created regardless of the improved existing technologies. WHO (2017) on the other hand, observed that safe drinking water, sanitation and good hygiene are fundamental to health, survival, growth and development. The literature asserts that conservation of this natural resource should be given more attention with the focus on the country's economic growth as one of the basic requirements. Moreover, Varis *et al.* (2017) regarded water as the most fundamental natural resource indispensable to life, environment, power generation, food production and hygiene. Water has always played a central role in human societies. It is a key driver of sustainable growth and poverty alleviation as an input in almost all production in agriculture, industry, energy and transport (Sadoff *et al.* 2020).

2.3. Uses of water

Water has a special significance not only in the preservation of life but also in the fulfilment of the goals for economic growth (Kılıç, 2020.). Sabino & Pulhin (2021) reasoned out that all people have certain needs without which life would be impossible. Such life-sustaining basic human needs include food, shelter, health, security, with water usage as determinant of how each them is achieved. When any of these is absent or in critical short supply, a condition of absolute under-development exists. Njora & Yilmaz (2021) argue that the incorporation of basic needs in water provision leads to the establishment of a minimum level of access to potable water regardless of people's affordability. Nepomilueva (2017) stated that for livestock farmers or people who grow food for own consumption as a life necessity and for survival usually use water. Some of the functions provided by water are transportation and purification of certain waste products, subsistence or commercial supplies of fish and plants, opportunities for recreation and conservation of nature such as flora and fauna (Nieves-Cordones *et al.*,2019).

Subramanian (2018) highlights that industries use water for fabricating, processing, washing, diluting, cooling, and transportation of products. In addition, large amounts of water help to produce mostly food, paper, and chemicals. In smelting facilities and petroleum refineries water is a raw material. In mining, water is a requirement for the extraction of minerals that may be in the form of solids such as coal, iron and sand. Gravel, liquids such as crude petroleum and gases, such as natural gas (Bichueti *et al.*, 2018). The agricultural sector in South Africa is the highest consumer of water accounting for about 62% of the total water consumption, while domestic and industrial water use account for 6% and 32% respectively (Reddick & Kruger, 2019). Kilic (2020) stated that water plays a significant role in the improvement of food security and household income.

Water plays a central role in many religions and beliefs systems in South Africa. Communities and indigenous people have assigned religious and cultural values to water for generations. Water is a key element in cultural ceremonies and religious rites. In the rites and rituals performed by most religions, water is fundamental for spiritual purification (Schneider & Popovici, 2019). There are a range of practices performed by cultural and religious communities (Schneider & Popovici, 2019) that involve the use of water from sources such as rivers, streams, dams, and springs. Breen *et al.* (2006) stated that South Africa is a multicultural nation of beliefs, religions, and expressions that are associated with water. For example:

- To the San people, water is a symbol of life.
- The legendary Rain Queen (Queen Modjadji) in Limpopo Province is to have power over drought and rain.
- In Nongoma (Kwazulu Natal), where seven streams meet to form the Isikhwebezi River, the waters at this junction are to have healing powers.
- The Christian faith all over the world and South Africa in particular, uses water in baptism as a sign of acceptance of the Christian faith, and as a symbol of leaving the old ways and taking on the new life-giving, Christ-centred way.
- Islam indicates that water has qualities of being life giving, sustaining, and purifying.
- For the Hindus, water has the powers of spiritual purification.

- In Judaism, ritual washing restores and maintains a state of ritual purity.
- The initiation of young males and females into adulthood is a wide practice in the African culture and during these ceremonies, they use water to bathe and cleanse their bodies. This cleansing ritual symbolises maturity and plays an important role in the initiation process.
- During the initiation of a traditional healer, the apprentice is required to stay by the river for several days, during which time he or she is to meet the river spirits.

2.4. Geographical availability and accessibility of water

Availability of water may vary a lot over the years, or even between one year and another as well as from one place to another. Lezzaik & Milewski (2018) stated that Africa has abundant rainfall and relatively low levels of water withdrawals for major uses, while more than 75% of the people, particularly in North African countries such as Libya, Tunisia, parts of Algeria and Morocco are dependent on groundwater as a primary source of freshwater. Countries of Southern Africa such as Botswana, Namibia and Zimbabwe are also dependent on groundwater. The Nile River followed by the Congo and Niger Rivers are the major sources of water for the African continent (Gebrehiwot *et al.*, 2019).

The total surface water available in South Africa averages about 49, 200 million m³ per year, of which about 4 800 million m³ originates from Lesotho (Governing Board Induction Manual, undated). In South Africa, there is an uneven distribution of rainfall, with high variability and unpredictability (Botai *et al.*, 2018). The average rainfall is about 450mm per year, that is, about half the world's average of 860mm rainfall per year. Estimations are that by the year 2030 South Africa is anticipated to result in 17% deficit, which is inadequate to meet the basic needs (Akinyemi *et al.*, 2018). The low amount of rainfall calls for proactive measures such as control of river flows through building dams to secure the available water. The Orange, Vaal and Limpopo are South Africa's main river systems which together drain about 60% of the country's land and contribute about 40% of the total surface runoff. Approximately, 70% of South Africa's gross domestic product (GDP)

as well as the same percentage of the population obtain water from these rivers, making their judicious joint management of paramount importance to the country (DWA, 2004). For water supply, South Africans depend mostly on rivers, underground water, and dams, as the country does not receive sufficient rain.

Dams are constructed to ensure that there is enough water to drink, to grow crops and for industrial purposes. Furthermore, the construction of dams is to ensure that communities do not run out of water in times of drought and to prevent flooding when there is excess rain. In the Free State province for example, the Gariep dam on the Orange river is the biggest dam ever built in South Africa which stores about 5 500 million m³ of water (Weideman *et al.*, 2019). Based on current usage trends, South Africa is to face a water deficit of 17% by 2030, which will worsen with the effects of climate change. Since water is a shared resource, humans are at risk and thus it is critical for people to understand the impact thereof; and, to incorporate water management into daily lives of people (Colvin *et al.*, 2016).

In his 2010 national address, President Jacob Zuma highlighted that South Africa “is not a water rich country” (Wegelin & Jacobs, 2013). Hence, South Africa is a ‘water stressed’ country. This is largely due to climatic conditions in combination with population growth (Baatjies & Hendrickse, 2015). Stone (2016) further highlighted that South Africa is among the world’s 30 driest countries and it is currently facing serious water challenges related to ageing water infrastructure, a short supply of technical skills, shifting demand patterns, changing rainfall patterns and the worst drought experienced in 30 years is a major challenge. Low levels of rainfall are likely to be a contributor to the drying up of existing water bodies that in turn threatens people’s health. Without adequate water, food security and economic growth are negatively affected and sustaining livelihoods of people becomes a huge problem.

The demand for water in Limpopo province has drastically increased over the last decade placing pressures on the water resources available. The state of dams monitoring

program by DWS indicated that between October 2014 and October 2015 the volume of water stored in dams in Limpopo Province has decreased by 13% (Limpopo Environmental Outlook Report, 2016). Over and above the Limpopo Environmental Outlook Report (2016), warns about the overutilisation of water sources such as the Letaba and Olifants River. Besides overutilisation, a decrease of water because of climate change and deterioration in the quality of water in the province is compounded by increased sanitation needs and mining activities.

Climate change affects the primary determinants of water resource quality and availability by increasing the occurrence of water-borne diseases that affect aquatic species; it increases the risk of flooding and the prevalence of drought (Department of Environmental Affairs, (DEA) (2015). CSIR (2010) outlined the impacts of climate change on water resources as follows:

- decreased availability of water in rivers because of increased evaporation,
- temporal changes in high and low flows due to changes in rainfall patterns,
- greater flood incidences as heavy rainfall events increase,
- increase in risks to the quality of water in rivers and the promotion of algal blooms caused by increased scouring and erosion from high rainfall events.

When the population grows Water Demand Management (WDM) also increases. WDM should be in place in all municipalities to ensure that water is preserved and used in an efficient manner. Brentan *et al.* (2017) identified several challenges regarding WDM in that it transpires at local government level on a rather *ad hoc* basis, with very little planning with regard to the aims and objectives within a limited budget. There is in general very little progress to promote WDM. The strategies are still lacking in many municipalities, as the by-laws still do not include any specific measure to ensure effective WDM.

To ensure the sustainability of the inadequate water quantity available now, measures should be put in place to regulate water usage and avoid unnecessary wastage. Wanjiru & Xia (2017) cautions that if present trends in water usage and wastage continue, there

will come a time when all the fresh water resources will be fully utilised and options such as recycling and demand management, have to be explored at greater lengths. Such processes might only be feasible to the well to do countries in terms of affordability. Mitrokostas (2018) argues that most individuals may waste water daily without realising; for instance, by not closing the tap when brushing teeth, leakages and washing vehicles with municipal freshwater. Mandal (2016) highlighted the reasons or causes of water wastage which include the unsustainable water supply management by the government, leakages of pipelines, lack of technical resources used for water supply, lack of water regulatory systems to control water supply in public taps and careless household in terms of water usage. The industrial sector uses freshwater to produce goods and that is one of the areas where wastage of water is dominant. In urban areas, a huge wastage of water through over-flowing of water from reservoirs of multistoried flats, hotels, institutions, and governmental sectors challenge water availability.

Reader (2010) asserts that the basic needs approach is an approach to social justice that gives priority to meeting people's basic needs by ensuring that resources are sufficient and appropriately distributed to maintain all human lives at a minimal decent level. The problem of water supply and sustainability are international challenges. In addition, (Armah, 2018) highlights the basic needs approach's reasoning for every person to have access to enough basic goods and services to maintain a level of living above a minimum. Since accessibility of water is a constitutional right, people deserves to have access to this precious resource to meet their daily needs. In addition, Department of Planning, Monitoring and Evaluation (DPME) (2015) highlights the appropriate access to water is a minimum quantity of 25 liters of potable water per person per day or 6 000 liters per household per month at an estimated distance of 200 meters from a household. Access to improved water for drinking and other domestic uses, such as bathing, cooking, and washing of clothes, is a major developmental challenge in many developing countries (Khalifa & Bidaisee, 2018). Baker *et al.* (2016) indicated that only 20% of the global population had access to running water while over 1 billion people do not have access to clean water. UNICEF & WHO concur as they estimate that 663 billion people lack access

to water supply while 2.4 billion people lack adequate sanitation (UNICEF, 2017). Many governments and organisations in developing countries are therefore undertaking efforts to improve drinking water access to urban and rural populations. This in turn necessitates the 2030 agenda and SDGs of bringing water quality issues to the forefront of international action by setting Goal 6 to “ensure availability and sustainable management of water and sanitation for all” to respond to the pressing challenges posed by water quality issues (UN World Water Development Report, 2017).

In South Asia, 66% of the population has no access to improved water facilities. This is because there are no alternative water sources available as many of the poor fetch drinking water from polluted rivers, streams, and canals (Hasanain *et al.*, 2019). In China, research conducted on water related problems indicated that water accessibility problems critically affected food security (Wang *et al.*, 2017). Jepson *et al.* (2017) outlined that rural communities with access to sustainable safe water supplies have great potential for engaging in economic activities such as keeping of livestock to reduce poverty and improve quality of life. Communities with access to adequate water can grow vegetables that improve the nutritional status of families. This may allow for the selling of surplus production and can in turn raise funds for other household needs. Africa faces huge challenges that adversely affect public health, with ability to access clean water supply by both rural and urban Africans being the outstanding major issue among others. Roche *et al.* (2017) states that only about 16% of people in sub-Saharan Africa had access to available water through household connections. Not only is there poor access to available drinking water but there are also risks of contamination due to several factors.

Accessibility to sufficient water is a complex matter. Stein (2005) stated that when South Africa entered democracy in 1994, there were approximately 12 to 14 million people without access to safe water and more than 20 million without access to adequate sanitation. Since 1994, 21.1 million and 17.3 million people respectively receive basic water supply and sanitation facilities. Currently, 1.3 million households lack access to piped water supply facilities, while 4.5 million households lack access to basic sanitation

facilities (DWS, 2013). The provision of free basic water and more equal distribution of water for productive uses such as irrigation, mining, and industry are important instruments to redress inequities of the past and eradicate poverty in South Africa (Marcatelli, 2021). However, the provision of free access to basic water services for all users is still a major challenge for the water sector (Matseke, 2020). Many governments and organisations in developing countries undertake efforts to improve drinking water access to urban and rural populations. Accessibility of water sometimes dictates usage of water depending on the quantity received. Wrisdale *et al.* (2017) highlighted that accessibility of water influences its usage and consumption patterns in both developed and developing urban and semi-urban communities.

Factors such as the distance the consumer has to travel to the water source, income of the consumers, the level of education of consumers, their religion and culture, the nature of housing and type of water using appliances and patterns play a significant role in defining water accessibility. Mulenga *et al.* (2017) argued that household income is one of the main determinants of access to water and sanitation facilities. From a study conducted in Cape Town, South Africa, households with income of below R800 per month had limited opportunities to improve their water and sanitation conditions. Harris (2020) outlined that this is because the low-income groups are unable to afford high connection fees to piped water and hence their limited water accessibility. In contrary, higher income groups could afford to buy more water and also able to afford private alternatives in times of shortages that might remain too expensive for the rural poor people as they are only able to meet the basic needs.

2.5. Quality of water

Water can have different qualities, such as temperature, colour, taste, and odour. These qualities influence the suitability of water for other purposes. There are literally hundreds of water quality variables, but for the purpose of this study, only a few variables are of interest (Omer, 2019). There are various factors influencing the perception of drinking

water quality such as human sensor perceptions of taste, odour, and colour of water, which relates to mental factor. These factors are most important because they may detect contamination related to chemicals. People may perceive risks if they experience health problems caused by poor water quality (Zulkifli, 2018).

Water pollution will continue to exist for as long as there is direct or indirect discharge of pollutants into water bodies without adequate treatment of the harmful compounds (Li *et al.*, 2017). The point source contamination may come from specific locations such as underground storage tanks, septic systems, and landfills; Whereas, non-point source contamination arises from influx of pollutants over a large area, such as from agricultural wastes and urban storm-water runoffs (Basheer, 2017). Africa alone experienced nearly one-third of all water-related disaster events that have occurred worldwide, with nearly 135 million people affected by drought (Nguimalet, 2018). In Malawi, nearly 50% of all illnesses relate to waterborne diseases such as cholera, shigellosis and typhoid fever due to lack of sufficient potable water of good quality (Mkwate *et al.*, 2017). In South Africa, the scarce freshwater is decreasing in quality because of an increase in pollution and the destruction of river catchments, caused by urbanisation, deforestation, damming of rivers, destruction of wetlands and energy use. As the human population increases water quality also decreases (Randwater, undated).

Mining, industry, agriculture, and development pollute South Africa's natural water resources. A dramatic turn-around to address further pollution levels is necessary. Challenges regarding water quality faced by South Africans as highlighted by Edokpayi *et al.* (2017) are acid mine drainage and levels of eutrophication, which are higher than elsewhere in the world. Gyamfi *et al.* (2019) further added that heavy metal pollution, an increase in cyanobacteria, and the dumping of untreated sewage also contribute to water quality challenges in the country.

In South Africa, measurement of water quality is per SANS 241 drinking water specifications, which include the constituents such as the chemical quality,

microbiological and physical quality (DWAF, 2005). Safe drinking water that complies with the SANS 241 drinking water specifications does not pose a significant risk to health over a lifetime of consumption, including different sensitivities that may occur between life stages of babies, and the elderly. Improving access to safe drinking water can result in tangible benefits to public health. Every effort should therefore, be made to achieve drinking water quality that complies with national safety standards (DWAF, 2005). DWAF (2005) further adds that in South Africa, drinking water is often of poor quality in many non-metropolitan areas. Discharge of waste into the water resources, disposal of waste on land in a manner that have a detrimental impact on the water resources and use of waste on land should be well regulated to ensure that the water resources stay fit for use (Thompson, 2006). Table 2.1 highlight some of the major categories of water pollution (Miller, 2002)

Table 2.1: Major categories of water pollution (Miller, 2002).

Category	Example of pollutants	Major Sources	Harmful effects
Infectious agents	Bacteria, viruses, protozoa and parasitic worms.	Human and animal waste.	Waterborne diseases
Inorganic chemicals	Water-soluble acids, compounds of toxic metals such as lead, arsenic and selenium. Salts such as NaCl in ocean water and fluorides found in some soils.	Surface runoff, industrial effluents and household cleansers.	Can make freshwater unusable for drinking or irrigation. Crippling spinal and neck damage, damage the nervous system, liver and kidneys. Lower crop yields and accelerate corrosion of metals exposed to such.
Organic chemicals	Oil, gasoline, plastics, pesticides, cleaning solvents and detergents.	Industrial effluents, household cleansers and surface runoff from farms and yards.	Can threaten human health by causing nervous system damage, reproductive disorders and some cancers and are harmful to fish and wildlife.
Plant nutrients	Water-soluble compounds containing nitrate, phosphate and ammonium ions	Sewerage, manure and runoff of agricultural and urban fertilisers.	Can cause excessive growth of algae and other aquatic plants, which deplete water of dissolved oxygen. Drinking water with excessive levels of nitrates lowers the oxygen carrying capacity of blood and can kill unborn children and infants.

From the table it is evident that there are various forms of pollutants that result in water scarcity as the water becomes unconsumable.

2.6. Water scarcity

Water scarcity is both physical and economical. Nepomilueva (2017) highlighted that physical water scarcity occurs naturally in desert or arid regions where water availability is restricted by nature. It occurs when the demand outstrips the land's ability to provide the needed water. In some instances, poor water management and distribution at catchment areas can cause physical water scarcity downstream. According to Long *et al.* (2017), economic water scarcity means that even though water may be naturally available, human, institutional, and financial issues limit access to clean water. In addition, Nepomilueva (2017) outlined that economic water scarcity refers to a condition where water cannot be utilised due to lack of resources, proper management, or simple inability to pay for access to a water source.

Byker *et al.* (2019) highlighted that the water crisis faced today in many countries is not about having too little water to satisfy human needs; rather, poor water management leads to billions of people and the environment suffering badly. In addition, climate change on the other hand increases water scarcity in some parts of the world. The rising level of the earth's seas, the rapid melting of glaciers, the frequency and ferocity of hurricanes, floods, and drought as consequences of climate change are also pointed out by many experts as factors for water crises. All these factors threaten the quality and quantity of the community's water supply, and also destroy crops, contaminate freshwater bodies and damage water facilities (Mehran *et al.*, 2017).

Many countries in the Near East and North Africa suffer from acute water scarcity, as do countries such as Mexico, Pakistan, South Africa, and large parts of China and India (Dinar *et al.*, 2019). South Africa is a relatively dry and drought prone country with limited water resources. High population growth rate over-stretched the freshwater resources leading to water scarcity and thereby translates to low water supply (Crookes *et al.*, 2019).

Table 2.2 shows the effects of population size on water scarcity. Out of the 15 countries of the Southern African Development Community (SADC), only 07 countries in the table indicate the effect of population growth on water availability. In 1995, South Africa had a very high population of about 34.9 million, compared to other countries and was therefore in a water stress stage. Currently it is declared a water scarce country with a population of 51 770 560 (Census, 2011). The table further highlights that in 2025, the country will be in absolute scarcity and it is quite likely to become true if the trends in population growth do not change.

Table 2.2: The 1995 and predicted (2025) population size and water scarcity. Adapted from (SADC, IUCN, SARDC, World Bank, 2002)

Country	1995		2025	
	Population (millions)	Water scarcity Index	Population (millions)	Water scarcity Index
South Africa	39.4	Water stress	50.1	Absolute scarcity
Lesotho	1.9	Quality & dry season problems	3.4	Water stress
Swaziland	0.9	Quality & dry season problems	1.8	Quality & dry season problems
Namibia	1.5	Adequate	2.4	Adequate
Botswana	1.4	Adequate	2.2	Quality & dry season problems
Zimbabwe	11.5	Quality & dry season problems	17.3	Water stress
Mozambique	15.4	Adequate	26.7	Quality & dry season problems

Mehran *et al.* (2017) was of the view that the major factors contributing to water scarcity include drought, lack of water near people's homes, high water tariffs, and overuse of lakes, waterways and aquifers. Other causes range from flooding to poorly placed dams. However, Highsmith (2019), argued that the leading cause of water crisis is mismanagement by government officials.

2.7. Impacts of water shortage

Water shortage threatens human health, limits food production, reduces ecosystem functions, and hinders economic growth. Water quality degradation translates directly into environmental, social and economic problems (Alrumman *et al.*, 2016). As a result of poor quality and quantity of water, high incidences of water related diseases are causing a significant damage to human well-being while poor sanitation practices are likely to be the cause of waterborne diseases (Raut, 2015). Diarrheal infection alone is responsible for 1.8 million deaths a year worldwide, of which 90% are children the under age of five (Mandefro, 2015).

This situation may lead to insufficient water for human consumption. In 2016, South Africa experienced one of the worst droughts ever in decades. Many towns and cities across the country have a compromised water supply systems and limited food production that placed pressure on an economy that is already fragile (Fisher-Jeffes & Carden, 2017). The Water Wheel (2017) added that South Africa has been through one of the worst droughts in recent history, and that the Western Cape Province experienced its worst since 1904. The agricultural industry and the mining sector are both struggling in the wake of the recent drought, while tourism industry is also set to encounter difficulties due to lack of water (Vaal University of Technology (VUT), 2017).

Water shortage affects the availability of water for urban and industrial use. Shortage of surface water may put tremendous pressure on groundwater whereby over-pumping of

groundwater by users to compensate the surface shortage reduce recharging due to less percolation that may trigger the rising of saline water levels nearer the ground surface (Wagan and Khoso, 2013). Shortage of water seems to worsen with the ageing of existing water schemes initially designed to serve a small population. Furthermore, lack of water creates food shortages, raises food prices, and increases a country's dependence on food imports (Population Institute, 2010). It is also argued that water shortage increases food prices, which proportionately affects most vulnerable members of society (VUT, 2017). This implies that water shortage may lead to food insecurities as farming and other crops that need water to grow will have a lower yield. Some farm animals will die, and others will not do well without water and that will trigger hunger in societies. Poor communities that cannot access water supplies particularly in urban areas often have no option but to spend more money they can barely afford to buy water from expensive water vendors who obtain water from unaccountable sources (Ngima, 2015).

Shortages of water could become a major obstacle to public health and development and thus prevent people from practising proper hygiene habits, such as washing hands before eating or after using latrine. Water shortage may also limit the ability to grow and water vegetables, thus depriving individuals of essential nutrients needed to prevent diseases (Tarrass & Benjelloun, 2012). Prevalence of inadequate water affects the health of 1.2 billion people worldwide and contributes to the death of approximately 15 million children annually. Half of the population in developing countries is suffering from water-related diseases; and in others, nearly 80% of the diseases that are water-linked, lead to 3 million early deaths (Population Institute, 2010). United Nations Development Programme (UNDP) (2006) added that a lack of clean water causes illnesses such as diarrhea or cholera that have an impact on the happiness of people and their relatives. Above all, these diseases may result in deaths that represent around 5% of the total deaths in the world, thereby creating much human suffering.

The worst impact of water shortage is that, it can create bitter controversy and disharmony between provinces and countries, which may affect national integration (Farhan, 2013).

Water conflicts can arise in water stressed areas among local communities and between countries. This often occurs in areas where clean water source separates two republics or civilisations. Sharing a very limited and essential resource is extremely difficult and the lack of adequate legal instruments exacerbates difficult conditions already in existence (UN-Water, 2006). Three noted hot spots for conflicts related to water around the globe include the Middle East where nearly 5% of the world's population fight over just 1% of the world's freshwater supply in this part of the world and disputes often break out in villages along the Tigris, Jordan and Euphrates Rivers. In Africa, conflicts between tribes have broken out over control of the Nile River through Egypt, Ethiopia and Sudan. In central Asia, the areas surrounding the Aral Sea break out in conflict from time to time during water shortage (Hussein & Grandi, 2017).

2.8. Factors that contribute to water supply constraints

Factors that contribute to water supply constraints are the following: population growth and urbanisation; corruption by government officials; vandalism and theft of water equipment and infrastructure; ageing infrastructure; shortage of skilled staff in the water sector and limited capacity of financial management.

2.8.1. Population growth and urbanisation

Urbanisation refers to the general increase in population in an urban area and the amount of industrialisation of a settlement (Uttara *et al.*, 2012). Population growth and urbanisation are some of the major contributors to water shortage. The world is becoming more and more urbanised. Cox *et al.* (2018) estimated that by 2030 about 60% of the world's population will be living in cities. Ewemoje *et al.* (2017) was of the view that urbanisation is a complex trend witnessed across the globe. Africa is said to have experienced the world's most rapid rate of urbanisation as cities face the pressure on natural resources; and water is one of such resources which its provision can be complicated through quality and quantity deterioration. Soga *et al.* (2017) added that

population distribution and trends may affect water quality which places a further massive strain on existing water and sanitation infrastructure.

South Africa's current estimated population stands at 58, 78 million, according to the released 2019 mid-year population estimates (Statistics SA, 2019). Estimations are that by 2025 the country's population shall have doubled and that there will be insufficient water for domestic, agricultural, and industrial uses (Toerien, 2018). Consequently, South Africa will face a situation where municipalities and service providers are under ever-increasing pressure as poor people migrate from rural areas to urban areas in search of work to improve their living standards. This influx leads to large-scale urban unemployment and increase in waste water; consequently put strain on the municipalities and the service providers since the rural immigrants cannot afford the services they need (Soga *et al.*, 2017)

Population growth and urbanisation translate into an increase in food production and more industrial activities. With agriculture and industrialisation being the two large water consumers, even though these activities take place in different places, the water required for these activities remain the same on a global scale. In developing countries, urbanisation typically occurs spontaneously, without any plan and this is a challenge to water supply systems (Van der Bruggen *et al.*, 2009). Restrictions and limitations of water availability further exposed by climatic conditions and increased water demand owing it to population, economic growth together with urbanisation (Baatjies & Hendrickse (2015). In addition, the more the population grows, the more the competition for water use increases in different sectors such as domestic, industrial, agricultural and municipal. Soga *et al.* (2017) supports the assertion by stating that the more people there are, the more resources such as freshwater, will humans ultimately consume.

2.8.2. Vandalism of water infrastructure

Theft and vandalism have become major emerging challenges that municipalities are battling to contain. Johnson (2014) stated that the root causes of the problem included, among others, the inability of politicians to deliver on promises that leads lack of trust by communities and ultimately give rise to unrest and protests. The availability of markets for stolen goods like cables and valves also present good business opportunities that interrupted the level of water service delivery. However, the Congress of South African Trade Unions (2014) stipulated that the underlying causes of vandalism and theft of water infrastructure is attributed to apartheid and colonial neglect, and that after 1994 there had been insufficient investment in infrastructure, and the privatisation of water services had worsened the situation. However, the portfolio committee on water and sanitation said that the on-going vandalism and theft of valves, copper wires and transformers has a direct bearing on water scarcity in many municipalities across South Africa (More, 2014). The act of vandalising and stealing of water infrastructure deny people of their basic right of access to quality water as well as putting pressure on budgets, because of infrastructure replacement and maintenance. (The Citizen, 2014). The various forms of vandalism include fire hydrants, cutting of steel pipes crossing rivers for sewer and water, damage to pump-stations and pipework, theft of electric motors, electrical cables, meters, standpipes, fences and access gates, tampering with telemetry systems, pressure control and insulation of valves (South African Local Government Association, 2004). It often happens that, as communities protest, they tend to vandalise infrastructure to indicate their anger or concerns towards government officials and that in turn creates a backlog on water service delivery.

This act of protesting that turns out to violence, was experienced in most provinces in South Africa. According to DWS (2013), in the year 2012 there were about 71 protests associated with dissatisfaction in the water sector. Morudu (2017) noted that reasons given by people for dissatisfaction with the delivery of basic municipal services such as running water, electricity, sewage and employment, infrastructure, housing added to the growing dissatisfaction in poor communities and triggered people to protest. Allegations

of corruption within local municipalities also add to the reasons that trigger protests in communities.

2.8.3. Ageing infrastructure

Water supply infrastructure management is a significant short and long-term challenge facing some water boards in the country. Infrastructure technical disciplines are experiencing a steady depletion of skills and ageing of resources in South Africa (National Electricity Regulator, 2004). Some of the local municipalities lack capacity to operate and maintain water infrastructure. Allen *et al.* (2018) asserts that subsequent lack of maintenance coupled with no control over the high levels of informal connections means that the majority of water schemes are no longer capable of providing a consistent daily basic water supply. Nadine (2016) reported that most of the country's water supply infrastructure was ageing. The neglect of maintenance was for a long time and that has worsened the effects of drought as a large percentage of water loss due to old infrastructure.

CSIR (2006) reported that a loss of intellectual assets and key technical staff, and the non-replacement, or replacement by others, who are less qualified or experienced, is inhibiting infrastructure maintenance and in many cases, identified as the main reason for a breakdown of the service. Van der Walt (2016) reported that a lack of proper documentation, monitoring and co-ordination at all the three levels of government has a negative impact on water service delivery. When there are no agreements governing co-operation, operational aspects or maintenance of water service systems the lifespan of infrastructure deteriorates.

Pot (2019) states that the government has taken measures such as developing a capital investment in municipal infrastructure to improve and address the issue of ageing infrastructure. For municipalities to be successful in combating the constant challenge of

replacing infrastructure and incurring unnecessary cost, sufficient budgetary funding need to be allocated to keep infrastructure in a good condition.

2.8.4. Shortage of skilled staff in the water sector

The skills' shortage crisis in government especially in managerial and technical positions curbed by very weak financial management systems in some instances contributes to failure of water service delivery. By retaining skilled staff and training new personnel, poor service delivery can improve. A reliable water supply in communities and the business sectors does not primarily depend on the processes and systems only. It also depends on the availability of professionals within the water sector. Shortage of money in some municipalities leads to having a small number of employees with more workload that tends to interrupt proper water distribution (IMIESA, 2015). Training on different issues like leadership, management and negotiation skills to enhance capacity to identify, manage and mobilise resources effectively in the local government institutions needs to be improved. Such qualities enhance the accountability and transparency of operations in the public and private sectors. As a result, they should be encouraged both within the institutions and towards the public (Tortajada, 2010). CSIR (2006) identified the following issues about shortage of skilled staff that affect stable water supply:

- The loss of skills and mentorship following the departure of experienced staff.
- Little or no career-path planning and succession planning.
- Loss of not only the most highly trained staff, but also of the middle order who had worked their way up through the ranks to supervisor positions.
- Appointment of non-technical personnel to management positions with no required technical experience.
- Shortage of suitable and trained engineers in the job market.

This suggests that the few employees should have a sound knowledge base to make informed operational decisions. In order to achieve water quality needs in an efficient manner, regular training of employees on methods to perform tasks needs a constant

practice. DWAF (2005) emphasised that training on Water Quality Management should include:

- An understanding of preventative drinking water quality management from catchment to consumer.
- Knowledge of the treatment process required to produce safe drinking water.
- Routine operating procedures for operating under drinking water quality failure conditions.
- Sampling procedures and the use of monitoring equipment to enable staff to collect representative samples and interpretation of drinking water quality results against standards.

Many water utilities are facing human resources shortfalls, while the challenge to retain experienced staff is equally significant. Many leave their jobs to take higher paid positions in other sectors, but the loss of skills and knowledge due to retirement without suitably qualified replacements is a serious issue faced by utilities worldwide. Simultaneously, the level of expertise required for operation and maintenance keep increasing as water technologies become more complex and the industry turns to more automated processes (Davix & Guio, 2016).

The World Bank report of 2008 identified some of the features that lead to deterioration in performance by government sectors as observed by Macanda (2007) which include:

- Substantial under-staffing.
- Lack of workforce planning.
- Deterioration of real salaries or wages plus a high degree of wage compression.
- Lack of morale or motivation on incentive problems.
- Departmental units.
- Defective managerial competence.
- Over-centralisation and over-concentration of powers and functions at the national level.

- Poor physical work environment and poor facilities.
- Logistical problems.
- Lack of political direction and commitment that lead to apathy and inertia.
- Serious deficiencies in training institutions and programmes.

2.8.5. Financial management capacity

Financial management deals with activities such as cash management, formulation of financial objectives in support of strategic plan and monitoring of cash flow. The ultimate goal of financial management in government is to ensure that managers safeguard and use available funds and other scarce resources in the best interest of the nation (Pauw *et al.*, 2002). Some government departments experience situations where there is poor or lack of financial capacity to meet their needs. As a result, the government end up contracting private entrepreneurs as an alternative way of administering performance to provide public service. Hendricks (2008) emphasized that financial sustainability requires timely collection of payments and cost recovery relating to capital asset values and rates of return on investment. Failure to cover costs leads to underinvestment in assets, weakened operations and declined service quality. Financial performance of an organisation is important whatever its regulatory framework.

DWAF (1994) stated that the cost of water supply system consists of three basic components namely, capital costs that include the cost of storage facilities such as dams and reservoirs, water treatment plants and pump stations. It also consists of operation and maintenance that include the cost of maintenance, operation staff and electricity for pumps. In addition, costs include replacement of broken pipes and fittings, and the costs of chemicals for treating the water. Replacement costs include the money required to replace an engine or a pipeline that has reached the end of its lifespan.

2.9. Intervention strategies for water shortage

Water resource management is a very complex process that requires cooperation among various levels of government and the active involvement of consumers and authorities. Consumers are usually aware of the nature of water resource endowment in their areas that often aid communities to make sound choices in order to effectively manage the limited water resources, use them equitably in a sustainable manner (Hirji *et al.*, 2002). There are several national and international policies and sustainable development goals formulated to guide the use of water as a special resource vital for human survival, to address the need for water supply improvements and to augment the issue of water demand. World Bank Institute (2006) stated the following principles recommended at the international conference held in Dublin, Ireland in 1992 on water and the environment, to guide global water management and development efforts:

- Freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment.
- Water development and management based on a participatory approach, should involve users, planners and policy makers at all levels.
- Women play a central role in the provision, management and safeguarding of water.
- Water has an economic value in all its uses and should therefore, be recognised as an economic good.

Furthermore, the World Summit on Sustainable Development (WSSD) held in Johannesburg in the year 2002, concluded that the key words of water management must be improved access, improved efficiency, better watershed management and reduced leakage (WSSD, 2002). The United Nations water for life decade report (2005-2015) estimated that by the year 2025, approximately 3.4 billion people will live in countries defined as water-scarce. Since water scarcity is a global crisis, urgent interventions that are sustainable need to be in place. Sjömander Magnusson (2005) highlighted the primary goals of the African water vision for 2025 at the second world water forum in The Hague in 2000, as to improve the motivation and skills of water professionals and to ensure that water pricing promotes equity and efficiency.

DWAF (2004), stated that the water and sanitation sectors' policy objectives for the New Partnership for Africa's development (NEPAD) was to ensure sustainable access to safe and adequate clean water especially for the poor; planning and managing water resources to become a basis for national and regional co-operation and development and systematically address and sustain ecosystems' and wildlife biodiversity.

The South African government took some initiatives to provide water to the heart of the country where most industrial and mining activities occur by establishing the Lesotho Water Project for a guaranteed ongoing supply of water. According to Waites (2000), the project transfers annually about 2 000 million m³ water from Lesotho to South Africa. The National Development Plan (NDP) was in place as a means of dealing with the development problems in South Africa with the main objective being to eliminate poverty and reduce inequality by 2030. According to South African Human Rights Commission (2014), one of the key targets of NDP is to manage water resources including the development and maintenance of infrastructure, bulk water supply and wastewater management as part of vision 2030 which seeks to see all South Africans having access to affordable sufficient safe water and sanitation.

In ensuring the sustainability of the little water available, measures need to be in place to regulate water usage. In addition, as the population grows, water demand also increases. Sibanda (2002) defines WDM as measures that improve efficiency by reducing water use or alternative patterns of water use after abstraction. WDM should be in place in all municipalities to ensure that water is preserved and used in an efficient manner. WDM measures can be for a short or long term depending on the needs of the community concerned.

According to The Water Wheel (2018), WDM plan may involve a wide range of demand management measures that include:

- A cost-reflective pricing; universal customer metering.

- Reticulation leakage detection, repair programs and pressure reduction.
- A communication strategy, including a community education campaign.
- Customer advisory services, the use of incentives for installation and/or retrofitting of water efficient equipment.
- Reduction of water use by the water utility and regulation of the efficiency of water using appliances, especially in new buildings.
- Use of reclaimed water to reduce the need for freshwater supplies and water use restrictions, either on a temporary or permanent basis.

The water wise education team at Rand Water outlined that the real solution to minimise water wastage is to change attitudes towards water. South Africa needs to become “Water Wise” which means that people need to have utmost respect for water and all life; use water carefully and not waste it; not pollute rivers with liquid and solid waste; pay for water services; take action to solve any water problems, conserve water and thereby conserve the natural environment (Rand Water, undated). The costs of water supply are very high and yet every water service provider should ensure a sustainable water supply to all communities within its jurisdiction. Water cost recovery is likely to be a key to financial viability and may be a solution since water is a scarce resource.

During his inauguration speech, the executive mayor of Capricorn District Municipality (CDM), Mr. John Mpe, emphasised that for cost recovery plan to be successful, proper water infrastructure and refurbishment of old water systems should be in place (CDM talk, 2016). This becomes achievable when community members incorporate water conservation into their daily tasks to avoid big charges on service delivery. Mbokazi (2009) defined water conservation as the efficient use and saving of water through measures such as water saving devices, water efficiency processes, water demand management and water rationing.

The environmental management framework as included in DWAF (2002) emphasised the development of systems to store and transport water which include the construction and

operation of large dams, tunnels, pipelines and the local construction of systems of weirs, pump stations and irrigation canals. To increase the norm of water conservation further, The Water Research Council (2018) indicated that tiered pricing system can allow communities to save water based on charging customers depending on how much water they use. Customers who use more than the level deemed necessary for human consumption pay a higher rate for the additional water. Water restrictions are commonly applicable in most rural areas and the practice has now escalated to townships and cities since water demand has increased in these places. DWS (2015) stated that water restriction is a limitation that is in place on the use of water by members of the public. This limitation often comes from the municipality that lays the condition on how much water used during a particular period and place. This measure is effective in that it forces community members to be aware that everyone should contribute to saving water. In addition, it is also crucial to have more awareness campaigns on hygiene standards to minimise water related diseases.

2.10. Community participation

Community participation is an active process by which beneficiary client groups influence the direction and execution of a development project with a view of enhancing their well-being in terms of income, personal growth, self-reliance, or other values they cherish (Mbui, 2018). According to Zakus & Lysack (1998), community participation commonly refers to the collective involvement of local people in assessing their needs by organising strategies to meet those needs. Furthermore, Njogu (2014) defined community participation as a way of serving the interests of residents and helping them to cooperate and be involved in the planning and implementation of local programmes such as water and sanitation. From the above definitions, participation focuses on the involvement of beneficiaries and not the government personnel. Community participation serves as a means of providing and accessing information. According to Commins (2007), community

participation strengthens the relationship between community members and government and improves service delivery.

A proper relationship is a prerequisite between the community, the ward committees and ward councillors as representatives of government. Ward councillors as per their roles, need to recognise the basic community needs and address them in an efficient manner. Through public participation, communities obtain information about their local government plans and how the plans are achievable within the relevant timeframe and the available resources and budget pertaining to water service delivery. Mafunisa & Xaba (2008) highlighted in their study that ward committees help to rebuild partnerships and formal communication channels between communities and the municipal councils. They also act as a forum for communication between the ward councillor and the ward communities about municipal issues. A key to success for most projects implementation is through community participation. Momba *et al.* (2008) highlighted that community consultation, involvement and awareness can have a major impact on public confidence in water supply. Community participation improves knowledge about water issues and enhances the community to take responsibility of water services. The involvement of communities can ensure that people are aware of water problems in the area and can therefore trigger water usage in a sensitive way.

Seetharam (2010) advocated that civil society, the private sector, and government should work together to contribute to improved water management. ANC (1994) was of the concern that the structure of the local authority administration should be in such a way that maximum participation of civil society and communities is ensured in decision-making and developmental initiatives of local authorities. Councillors at local government level have a mandate to represent the community and that they are required to recognise the basic community needs and to address them in an efficient manner. It is of great importance to recognise the involvement of people in community projects so that the people can solve their own problems as a basic human right that is fundamental to the element of democracy.

Matshe (2009) asserted that public participation has as such been part of enhancing the constitutional democracy in South Africa. Public participation is one of the foundations of democracy. Communities need a sense of ownership in decision-making on major issues affecting them daily rather than dictatorship that in turn triggers violent protests. Section 16(b) of the Municipal Systems Act (Act 32 of 2000) stated that the municipality must contribute to building the capacity of the local community to enable members to participate in the affairs of the municipality. Councillors and staff must ensure that communities participate and use resources and therefore annually allocate funds in the budget that may be appropriate for encouraging community participation and capacity building. Therefore, municipalities need to effectively communicate and work with communities to fulfil their obligations.

According to the International Water Association (2004), access to good, safe and reliable drinking water requires an integrated approach, close cooperation and partnership between all stakeholders. Since public participation involves interaction and partnership, the interaction needs partners to communicate with one another in order to understand each other and reach a common goal (Mersham & Skinner, 2002). Matji (2003) outlined that communication (Figure 2.1) is vital for community participation in respect of the flow of information between different stakeholders in the community.

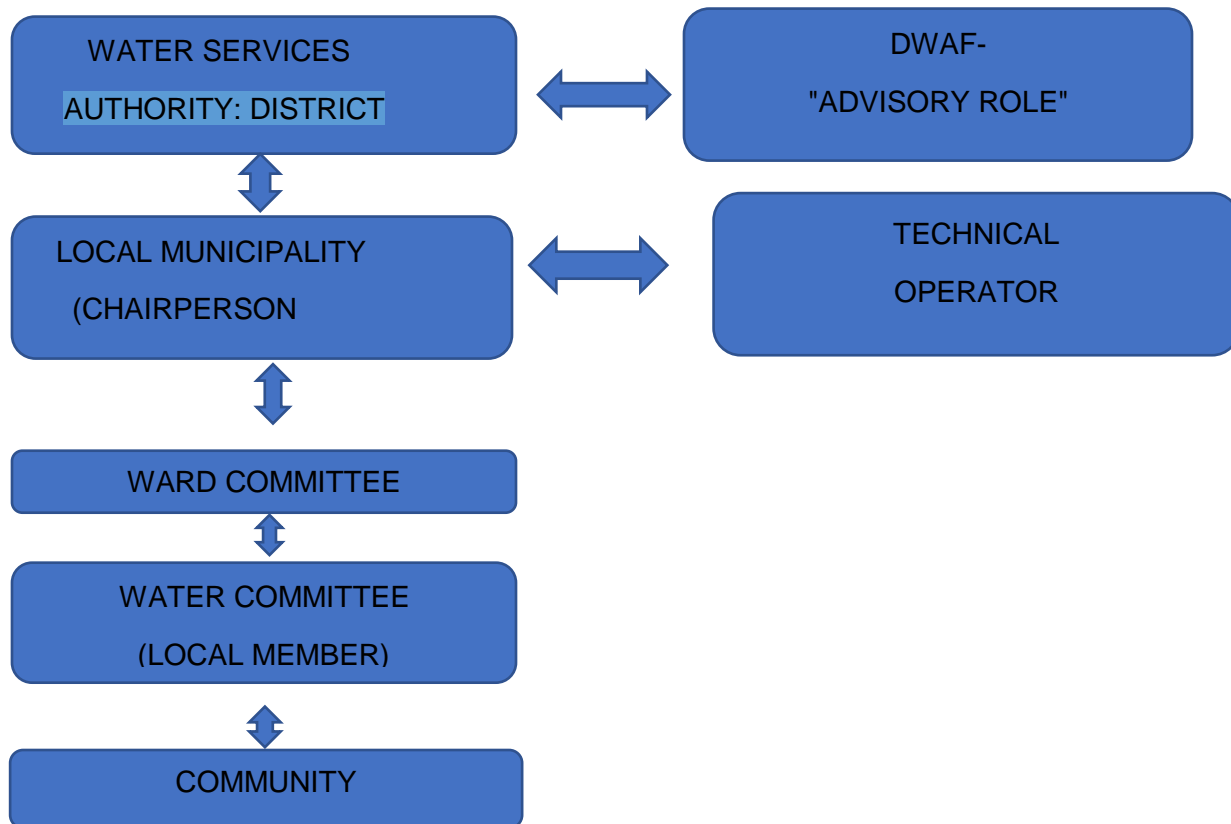


Figure 2.1: Communication model within the water sector (Matji, 2003).

Communication regarding basic service delivery should start at community level. Figure 2.1 shows that the community should be involved in elements of water services such as community water projects or issues on maintenance of water infrastructure. From the community, a water committee is formed which comprise of local members who represent the general community at large to liaise with the ward committee that engages local municipality and the technical operator who oversees maintenance of infrastructure. Should issues faced by a community not be resolved, the Water Service Authority (WSA) who then engages DWS takes over.

Moroe (2010) proposed methods in which people can communicate and participate for various purposes. The approaches include consultation that can occur through community meetings, ward committees, surveys, meetings with relevant sectors and community leaders, door-to-door campaigns, suggestion boxes and public hearings.

Feedback and information sharing are through advertisements, posters, community notice boards, newsletters, and bulletins.

Morebodi (2015) outlined that community participation is a widespread concern for both developed and developing economies around the globe. It appears that participation is crucial for a healthy and vibrant democracy. Community participation occurs in different forms amongst others namely: consultation prior to new developments, community forums and community specialised workers. Moroe (2010), further identified categories of more traditional forms of public participation such as:

- public meetings,
- consultations, documents, co-option into committees,
- question and answer session,
- customer-oriented categories such as service satisfaction survey, and complaints ,or suggestion boxes which are often used in relation to service delivery,
- innovative methods, which involve interactive websites, citizen panels, focus groups and referendums; innovative approach categories which encourage citizens to deliberate over issues, such as citizens' juries, community plans, needs analysis, visioning exercise, and issue forums.

From the list, it becomes evident that participation categories reflect the extent to which sincere participation is taking place in communities.

Water consumption and disposal often do not receive required levels of quality service as essential services. Hence, little is available about how much consumers are willing to pay for specific service level (Hensher *et al.*, 2014). Poverty is also a contributing factor to the non-payment problem as many need to use the little money they have on essentials and to pay for municipal services. Governing Board Induction Manual (undated) highlighted that poverty is one of the root challenges in the water sector, manifesting itself in the inability to pay for water services. According to Botes & Pelsler (2001), the financial inability to pay is the primary problem associated with the non-payment of services

amongst a considerable proportion of non-paying households. Poverty is thus, directly related to the ability to pay, but not to the willingness to pay (Hagg, 1998).

Kido (2008) further outlined that the provision of sustainable water requires funding. Financing often comes from cross-subsidisation through user tariffs. Water services are costly, starting from the abstraction, treatment, storage and supply that in turn requires a highly effective public involvement to educate residents on complexities of billing systems. The reasons for non-payment of water services differ from township to township. Smith & Hanson (2003) discovered that:

- Some residents are generally very confused by the frequency of incorrect billing procedures, false estimations on their accounts and discrepancies in billing systems.
- Residents choose non-payment to express their dissatisfaction over unmet expectations regarding improvements in water service delivery.
- The difficulty of householders in understanding their bills creates resentments to pay for their services.
- Some residents believe that water is a God-given gift, a constitutional right and an entitlement hence, they are unwilling to pay.

Bland *et al.* (2010) were of concern that there are substantial numbers of middle and upper middle wealth households that do not pay for their water, and the majority of non-payment occurs in many of the poorest households that are in rural villages. When the villagers are poor, the local administration is unable to maintain the infrastructure and to provide a reliable water supply source. When water supply infrastructure is out of operation many communities are to set up private solutions such as digging boreholes, which in turn add to the unwillingness to pay water fees (Rost *et al.*, 2015).

2.11. Role of Government in water provision

According to Gomez & Ravnborg (2011), water governance refers to a broad range of political, social, environmental, economic and administrative systems that are in place to

regulate the development and management of water resources and the provision of water services at different levels of society. From this definition, water governance mainly addresses questions like, “Who is making decisions on the right to water and its benefits? Who is making decisions about who gets water, when and how? Which voices are influencing decision-making? On which political and scientific basis are decisions made?”(Tropp, 2007). The issue highlighted by Dayem and Odeh (2010) is that the responsibility for managing water and water services is often across multiple institutions, which rarely communicate or coordinate. In that way, decision-making processes take a top-down direction with the absence of effective stakeholders’ participation. In addressing this problem, it is important to develop institutional arrangements that involve the public and private sectors, which are well equipped with the right technical, economic and legal tools that enable them to function effectively.

In terms of water provision, the levels of government are national, provincial and local. The Government Gazette (2002) stated that the key role of national government is to remain a custodian of the water resource, ensuring management in the public interest and to ensure that all citizens have access to adequate water and sanitation services. National government is the public trustee of the nation’s water resources, and is ultimately responsible to ensure that South Africa’s water resources are protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner for the benefit all persons in accordance with its constitutional mandate. On the other hand, local government has the primary constitutional responsibility to provide basic water and sanitation services to people living within its jurisdiction (Governing Board Induction Manual, undated).

Since the launch of the Reconstruction and Development Programme (RDP) by the ANC in 1994, the national government has been committed to RDP goals, one of which is to improve basic water services as well as to improve levels of services over time. Berger (2004) outlined that DWS’ core function is to ensure that all South Africans have equitable access to water and sanitation and the proper management of the country’s water

resources and forests in a sustainable manner. DWS is primarily responsible for the formulation and implementation of policy governing water and sanitation and has the overriding responsibility for water services provided by local government. The department also operate water resource infrastructure, water supply schemes and some retail infrastructure (Governing Board Induction Manual, undated).

The local governments are at the heart of development processes in South Africa, through grassroots linkages, infrastructure, investment programme, local economic development strategies, partnerships with the private sector and integrated development plans. Furthermore, the local government is the public services agency best able to have a direct and lasting impact on the lives of the citizens. The constitution and local government legislation give municipalities significant powers to deal with the challenges of ensuring effective service delivery to residents (RSA, 1998).

Since the aim of the local government is to provide basic services to people, everyone living within its jurisdiction should have access to adequate infrastructure and services. Municipalities are the local level of government as per section 151(1) of the Constitution and entrusted with provision of municipal service delivery. Du Toit *et al.* (2002) stated that the primary function of a municipality is to serve its community by providing water, electricity and sanitary services. The identified services are often basic services without which the community can live. In other words, a local municipality generally provides water services to residents with water that comes from local sources such as dams and rivers.

Local municipalities may have their roles that are completely different from provincial and national spheres of government. According to Botes *et al.* (1996) municipalities have the powers to make by-laws regarding water service. Still *et al.*, (2008), recommended that the model for water service by-laws should contain main provisions such as:

- Municipal consent for the installation of new pipes and fittings, standards pertaining to the quality and installation of pipes,

- Powers of the municipal authority to prevent wasteful use of water or impose restrictions on the use of water in the event of water shortages, droughts and floods.
- Prohibitions on the waste of water by consumers and requirement of regular water audit for water users who consume more than 3 650 kilolitres per year.

In each municipality, policies on water governance need to be established and be in practice to ensure a sustainable water supply. According to the Department of Provincial and Local Government (2004), to facilitate the process of water services, national government has taken initiatives to give water service institutions capital on an annual basis. The grants include municipal infrastructure allowance to expand the delivery of services to poor households and to alleviate poverty, municipal systems improvement grant to assist municipalities in building in-house capacity to perform their functions and stabilise institutional, and governance systems and equitable share to supplement municipalities' revenue to deliver services to poor households. In terms of Section 153 of the Constitution, the developmental duties of municipalities include amongst others, budgeting and planning processes to give priority to the basic needs of the community, and to promote the social and economic development of the community. This compels municipalities to carry the responsibility of providing residents within their jurisdiction with water, sanitation, transportation facilities, electricity, health services and security (South African Government, 1996).

Local governments are to compile the Integrated Development Plan (IDP) annually to determine and address the needs of each municipality and incorporating public participation. Mhone & Edigheji (2003) indicated that the IDP process requires enough time for the stakeholders to participate and that the critical success of the IDP lies in how the process is to allow maximum participation of all stakeholders. Parnell *et al.* (2002) stated that the IDP is an institutionalised mechanism for municipalities to achieve their responsibilities. The budget of the municipality includes all the projects that are active as detailed in the IDP.

Section 1 of the Water Services Act no 108 of 1997 defined a Water Service Authority (WSA) as any municipality including a district municipality responsible for ensuring access to water and sanitation services to consumers or potential consumers within municipal area. Haigh *et al.* (2008) suggested that municipality should gain authorisation as a WSA, in order that it should retain the right to extend the provider function to an alternative agent acting under its authority. According to the Governing Board Induction Manual (undated), WSA is responsible for ensuring access to water supply and sanitation services, responsible for planning, implementation, and operation of infrastructure. In cases where municipalities have difficulties in water provision, the private sector and water boards often intervene to uplift the burden of improper water delivery services to communities.

The WSA retains ultimate responsibility to ensure the delivery of service and to decide on the most appropriate mechanism to provide the service. DWAF (2003) highlighted that the municipality as a WSA should prepare a Water Service Development Plan (WSDP) to ensure effective, efficient, affordable, economical, and sustainable access to water services that promote sustainable livelihoods and economic development. Haigh *et al.* (2008) was of the notion that one of the critical gaps in local government is a lack of understanding of the full scope and value of the WSDP. It is obvious that when water services are effective at municipal level, local economic development can prosper. Thus, the need for planning and implementation should be emphasised.

Toxopeus (2019) argues that water boards are to provide water services to water service institutions, serve as a public water service provider and to assist some municipalities in terms of technical support when needed. Furthermore, Beck *et al.* (2016) highlighted the primary activity of water boards as providers of water services such as bulk potable water to other water service institutions within their respective service areas. Water boards play a significant role in the water sector within the country and mostly operate dams, bulk water supply infrastructure and wastewater systems.

The South African Institution of Civil Engineering (2011) is of the view that water boards are the institutional link between national and local government and are better equipped in terms of capacity and finance than municipalities. Infrastructure managed by water boards is usually in a better condition. The largest three water boards in the country are Rand Water, Umgeni and Overberg. Currently, Limpopo Province has Lepelle Northern Water Board that operates 20 water treatment schemes and 5 wastewater works spread across Capricorn, Sekhukhune, Mopani and Waterberg districts municipalities (Lepelle Water, 2014).

2.12. Legal framework for water services in South Africa

Since the dawn of South African democracy in 1994, the South African government took initiatives to address water supply and sanitation backlogs. The development of policies and legislations supported the initiatives namely: the Constitution of the RSA, the Free Basic Water Policy (FBW), the Water Services Act and the National Water Act (NWA) to name a few.

2.12.1. The Constitution of South Africa

Chapter two of the Constitution of the Republic of South Africa, Act 108 of 1996 comprises of the Bill of Rights that is the cornerstone of democracy in South Africa. The principles of access to sufficient and clean drinking water as a basic right are enshrined in the Bill of Rights. Section 27 of the Constitution stipulates that every person have a constitutional right to have access to sufficient water. The state should take reasonable legislative and other measures to achieve the progressive realisation of this right. Section 152 adds that it is the responsibility of local government to ensure the provision of services to communities in a sustainable manner; to promote social and economic development; and to encourage the involvement of communities and community organisations in the matters of local government. Section 74 (2) (c) of the Municipal Systems Act 32 of 2000, as amended, requires municipalities to provide basic services. In adopting the tariff policy,

the tariffs may for example, cover only operation and maintenance costs, special tariffs for low levels of consumption of services and subsidising the poor households.

2.12.2. The Free Basic Water Policy

The Free Basic Water (FBW) policy, officially launched in 2001, with the main purpose being to ensure that poor households who cannot afford to pay for services can at least have access to free basic level of water services. The South African standards relating to a 'basic' level of water supply is 25 litres per person per day. This amounts to about 6 000 litres per household per month for a household of 8 people. The volume of 6 000 litres per month has therefore, been set as the target for basic level for the households in South Africa (RSA, 1997). However, local authorities may have some discretion over this amount. In some areas, they can choose to provide a greater amount, while in other areas, only a smaller amount due to various reasons such as remote areas with scattered settlements, and that in water stressed areas it is often not feasible to provide water (DWAF, 2002).

All communities should have access to at least a minimum level of water provision since it is not a goal but rather a constitutional obligation. The development of new infrastructure and the rehabilitation and upgrading of existing infrastructure will help remove the imbalances that exist in communities regarding equal access to water services (Bekink, 2006).

2.12.3. The Water Services Act 108 of 1997

The Water Services Act 108 of 1997 provides for the rights of access to basic water and sanitation. The Act states that, "every water service institution must take reasonable measures to realise these rights. It also allows the minister of DWS to set national standards to ensure sufficient, continuous affordable and fair water services. Section 4 (1) (2) of the Water Services Act 108 of 1997, stipulates that water services must be

provided in line with terms and conditions set by the water services provider. These conditions should be accessible to the public. Subsection (2) (C) of the Act provides for the conditions for payment, tariffs and the circumstances under which water services may be limited or discontinued. Section 5 of the Act further states that, “if the water services provided by a water service institution are unable to meet the requirements of all its existing consumers, the water service institution should give preference to the provision of basic water supply and sanitation to consumers”.

2.12.4. The National Water Act 36 of 1998

Provision of water services in South Africa, is regulated by the National Water Act 36 of 1998. The Act is also responsible for ensuring that policies on water are developed and the necessary institutional framework is in place for local government to deliver water services. The purpose of the National Water Act 36 of 1998 is to consider the following responsibilities amongst others:

- Meet the basic human needs of present and future generations,
- Promote equitable access to water,
- Redress the results of past racial and gender discrimination,
- Promote the efficient, sustainable, and beneficial use of water in the public interest,
- Facilitate social and economic development,
- Provide for growing demand for water use,
- Protect aquatic and associated ecosystems and their biological diversity,
- Reduce and preventing pollution and degradation of water resources,
- Meet water management obligations,
- Promote dams’ safety and
- Manage floods and drought.

2.13. Summary of chapter

It is well established through the engaged literature that without adequate quantity and quality of freshwater, lives become negatively affected. Countries and continents will

remain in despair. Most economic activities could shut down and there would be no other form of development as most activities depend on water. Therefore, it is of great importance to save every drop of water and use it sparingly. The government alone cannot win the issue of service delivery without the appropriate support and active involvement of communities. The main function of every municipality is service delivery with water service delivery as one of the most prominent services. Water service delivery has proven to be a worldwide challenge since water is a basic need for any country's development, economic growth and health to mention but a few. Water is a valuable product that needs protection and preservation because it is the centre of all local and international countries' development.

This chapter covered topics on water as a natural resource, water availability, accessibility and quality among others. The impacts of water shortage and intervention strategies to water resource management are key issues attended to in this chapter. Factors contributing to water supply constraints included vandalism and theft of water infrastructure, corruption in the local municipalities, ageing of infrastructure, shortage of staff in the water sector, financial management capacity, population growth and urbanisation. Community participation, the role of government and legal frameworks on water service delivery are important concerns assessed. The legal frameworks aimed at putting together the set of regulations that control the provision of water services are crucial in laying the foundation for municipalities to render effective meaningful service delivery.

CHAPTER 3

RESEARCH METHODOLOGY

3.1. Introduction

The main purpose of this chapter is to explain in detail the methodology and research design used in this study. Detailed sampling procedures for the study, methods of data collection, data analysis and presentation of results are key elements in this chapter.

3.2. Research design

Research design is a series of guidelines and instructions towards addressing a research problem (Kumar, 2014). This study adopted both qualitative and quantitative research designs for collection and analysis of data. According to Merriam (2009), a qualitative paradigm involves the understanding of how people interpret their experiences, while Babbie and Mouton (1998) pointed out that a qualitative study attempts to understand human action from the social perspective. Rutberg and Bouikidis (2018) on the other hand, argues that qualitative research concerns itself mainly with social aspect of human life, the lived experiences and peoples' perceptions or attitudes in life. This project is aligned with phenomenology as some aspects of phenomenology entails on exploring lived experiences and perceptions. The reason for employing qualitative approach in this study is to describe and understand water supply constraints from both the experienced key informants and general members of the community affected in Giyani Township.

The quantitative paradigm is a formalised, systematic, objective and nomothetic approach to research whereby numerical data and statistical analysis generalise results from a sample group to the population (Pietersen, 2007). Creswell (2014) added that the quantitative approach is applicable after the collection of data in order to analyse and interpret the data in terms of statistical values. The non-experimental quantitative approach was employed in this study describe and understand the meaningful impact of water supply constrains in Giyani Township by collecting data from both the key informants and community members affected.

3.3. Sampling

Sampling is a process of selecting participants for a research project (Dane, 1990). In cases where the population is extremely large, the practical way to collect data is through sampling. The response are then generalised over the total population.

3.3.1. Sampling frame

Bless *et al.* (2006) defined sampling frame as the entire set of objects or people that are the focus of the research and about whom the researcher wants to determine some characteristics. The sampling frame for this study consisted of all the residents of Giyani Township. The overall total population of the township was 34 692 with 8 098 households. Section A, had a population of 5 461, sections D2 & F had 9 283 people and sections E & D1 with a population of 19 948 (Greater Giyani Municipality IDP, 2017/2018). Therefore, the sample frame for this study consisted of all the 8 098 households of Giyani Township.

3.3.2. Sample size

A sample size of a study refers to a chosen number of the population from which data is gathered (Lavrakas, 2008). The sample size for the study was 382 respondents obtained by using Slovin formula (Stephanie, 2003) given as:

$$n = \frac{N}{1 + Ne^2}$$

Where N = population, n =sample size, and e = margin of error

$$n = \frac{8098}{1 + (8098)(0.05)^2}$$

$$n = 382$$

3.3.3. Sampling techniques

Sampling techniques refer to the procedures the researcher adopts in selecting items for the sample (Kothari, 2004). The type of sampling technique used in this study was a

systematic sampling Systematic sampling is a plan in which the population units are collected systematically throughout the population Sayed & Ibrahim (2017). Systematic sampling ensures that each unit has equal chances of selection as the first unit. Therefore, 382 (three hundred and eighty-two) households were sampled systematically for the survey with an assumption that the selected sample would be representative of the whole township. To obtain the systematic value, that is, the skip interval of households see the formula that follows:

$$n^{th} = \frac{N}{n}$$

Where n^{th} = systematic value, N = population, n = sample size,

$$n^{th} = \frac{8098}{382}$$

$$n^{th} = 21$$

This means that the first household was randomly selected followed by every twenty-first household until 382 households were selected.

3.4. Data collection methods

Data collection method is a process of collecting information from all relevant sources to find answers to the research problem (Dudovskiy, 2018). The research study's aim guided the collection of data. Therefore, in order to obtain adequate information for the study, both primary and secondary data sources were consulted.

3.4.1. Secondary data

Secondary data is data not collected and processed by the researcher but by someone else for other purposes (Ramovha, 2016). In this study, secondary data was from journals, research thesis, textbooks, government documents, published articles and internet.

3.4.2. Primary data

Primary data is one that is collected afresh for the first time, and thus happen to be original in character. The sources for primary data are original sources from which the researcher directly collects new data from the sampled population (Ramovha, 2016). In this study, the researcher collected primary data from the residents of Giyani Township through questionnaires, key informant interviews and observation.

3.4.2.1. Questionnaires

A questionnaire is a research instrument that consists of a series of questions with a purpose for gathering information from respondents (Gillham, 2008). A questionnaire in line with the research topic assisted to gather data from the sampled respondents to achieve the aim and objectives of the study. Structured questionnaires which consisted of open-ended and close-ended questions were self-administered. The researcher conducted the questionnaires face to face and that gave the researcher an opportunity to have an in-depth probing of the respondents. In total, the researcher self-administered three hundred and eighty-two (382) questionnaires among the sampled respondents.

3.4.2.2. Key Informant Interviews

Key informant interviews are qualitative in-depth interviews of selected people for their first-hand knowledge about a topic of interest (Kumar, 2014). The researcher developed an interview schedule that served as a guide for conducting interviews with the key informants. The following key informants underwent an interview: plant superintendent, process controller, head of water reticulation services and maintenance division as well as the Greater Giyani Local Municipality representative. The researcher based the selection of the key informants on the understanding that they would provide relevant information pertaining factors that affect water delivery services in Giyani Township.

3.4.2.3. Observation

Observation method is a way of collecting information by the researcher's direct observation of the study area without asking the respondents any question (Kumar, 2012). Observation method enabled the researcher to understand the condition of the water infrastructure and the projects implemented to improve water service delivery in the

study area. The researcher lived in Giyani Township and worked in the relevant plantation for about two and half years that is from 2012 to 2014. The researcher used a checklist (appendix 2) to administer the physical condition of the water infrastructure. The observation over the period of two years of working in the area and the pictures taken helped to add value to the observed condition of the water infrastructure. This method also helped the researcher to have a general understanding of the study area on how the community perceived the importance of accessing potable water as a basic need and right.

3.5. Data analysis and presentation of results

According to De Vos (2002), data analysis is the process of bringing order, structure and meaning to the mass of collected data. Data classification into specific categories of themes was after the researcher transcribed and coded the recorded data. The variables that denoted themes were clustered together and those that denoted numbers were grouped together. The Statistical Package for Social Sciences (SPSS) version no 25 helped to analyse the quantitative data and the results were in the form of pie charts and bar graphs to summarise the research findings. To indicate the relationship between the chosen variables, the researcher used descriptive statistics including cross tabulations and Chi-Square

3.6. Summary of the chapter

The chapter presented the research methodology used in the collection of data for this study. The nature and design of the study was both qualitative and quantitative. The study area, population, sampling procedures, sources for secondary data and primary data collection methods which included questionnaire and interviews were discussed. Key informant interviews and observation as other methods of data collection were outlined.

Method of data analysis was fully highlighted. The next chapter deals with the research findings and discussions thereof.

CHAPTER 4

PRESENTATION AND DISCUSSION OF RESULTS

4.1. Introduction

This chapter presents findings of the study on the investigation of water supply constraints in Giyani Township. Data collection for this study was through structured questionnaires, observation and Key Informant Interviews (KII). The aspects that are examined in this chapter are demographic characteristics of the respondents, sources of water, uses of water, costs incurred to access water, amount of water used, seasonal water shortages, possible causes of water scarcity and measures to overcome water supply constraints in Giyani Township.

4.2. Demographic characteristics of respondents in Giyani Township

Demographic characteristics are statistical data about the characteristics of a population such as age, gender, and income of people within the population (Kenton, 2019). The demographic characteristics that involved educational and occupational levels of the respondents, households' monthly income, size of households and number of years respondents stayed in Giyani Township are key issues in this chapter.

4.2.1. Age of respondents in Giyani Township

In the context of this study, age refers to the length of time that a person has lived (WHO, 2013). The study targeted age groups 18 to 60 and above because in the South African context, a person is considered an adult from the age of 18; as for the purpose of this study, the person can be able to account or give a true reflection concerning water supply constraints in his/her area. Figure 4.1 shows distribution of age of respondents in Giyani Township.

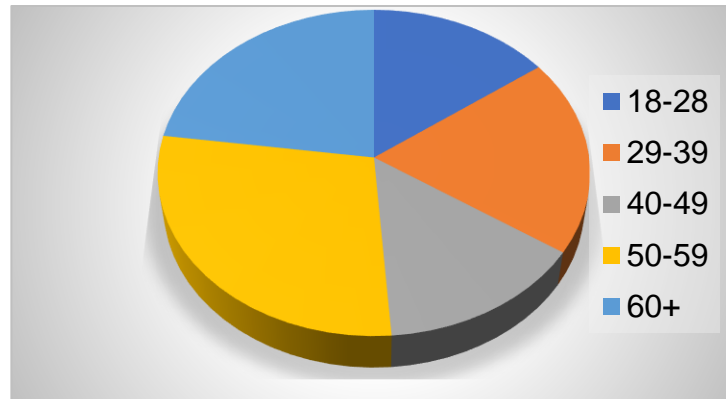


Figure 4.1: Age of respondents in Giyani Township

Fifteen percent (15%) of the respondents were of the age group of 18 to 28 years, 19% of the respondents were in the 29-39 years category and 15% were aged 40 to 49 years while 28% were in the 50 to 59 years category. The remaining 23% of the respondents were aged 60 years and above. In as much as the researcher intended to interview respondents who were 18 years and above, there was no specific age group identified for the study. However, it is worth noting that not all respondents were heads of households because the process of data collection took place when most household heads were at work. As a result, anyone at the age of 18 found in the house participated in the study.

4.2.2. Gender of the respondents in Giyani Township

Gender is a socially constructed concept derived when society ascribes different roles and duties, behaviours and mannerism of the two sexes (Schudson *et al.*, 2019). In this study, gender refers to the state of being male or female. Forty-nine percent 49% of the respondents who participated in the study were females and 51% were males.

There is a slight difference of 2% between the two sexes, which can be associated with the assumption that women empowerment takes place as more women seem engaged in many economic sectors. However, the results disagree with those of the study by Mavhungu (2011) on the non-payment for municipal services in the Vhembe district municipality, which indicated that 51% of the respondents were females and the remaining 49% were males. Traditionally, the expectations are that the number of females

found at home would be higher than the males. In the past, women would remain at home taking care of their homes while men were at work. It is worth noting that the research method depended on the availability of respondents and did not at any point favour any gender as participants in the study. A Chi-square test established whether there was any association between gender and water use for domestic or productive purposes.

Table 4.1: Association between gender and water use in Giyani Township

	Value	Degree of freedom	Significance
Pearson Chi-Square	3.451	1	0.05
Likelihood Ratio	3.424	1	0.05
No of Valid Cases	382		

Since the Chi-square value (3.451) is less than the degree of freedom (3.84) as indicated in table 4.1, there is no association between gender and water use in this study. This implies that each gender was standing a chance of using the same quantity of water as the other. However, it is a general expectation that females use more water than males as women are mainly involved in domestic chores that require the frequent use of water. Azuwike & Eboh (2019) advocated that gender influences how people access and use water and on the other hand, water influences social relations.

4.2.3. Educational level of the respondents in Giyani Township

Educational level refers to the degree of education an individual has completed (Baum *et al.*, 2015). It is essential to determine the educational level of the respondents because education plays a significant role in modern society. Again, it is also assumed that through education respondents may at least go an extra mile as far as proper knowledge of water

issues is concerned. Nonetheless, it should be noted that educational level was not a prerequisite for participation.

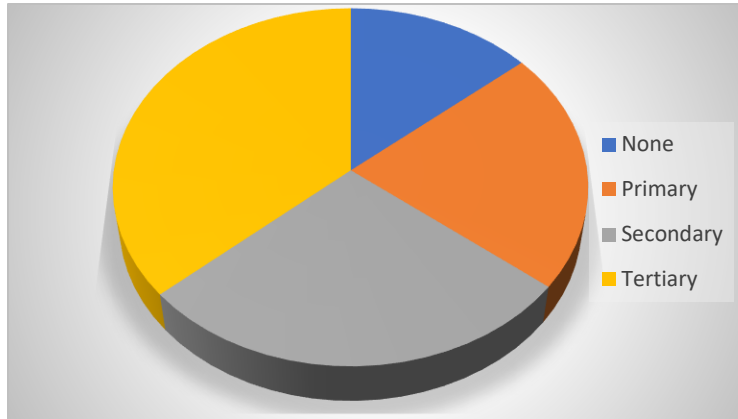


Figure 4.2: Educational level of respondents in Giyani Township

Educational level of respondents was categorised as follows: those who did not have any school qualification and those with primary, secondary as well as tertiary education. Figure 4.2 represents the educational level of respondents and the results indicate that 14% of the respondents did not go to school, 22% only attended primary school, 28% received secondary education and 36% of the respondents had tertiary education. It seems that education is valued in Giyani Township as a higher number of respondents have tertiary education. This could be associated with affordability to enrol at institutions of higher learning.

Ramsey *et al.* (2017) outlined that higher education levels correlate with higher levels of water consumption. On the other hand, some studies showed that people with higher education are more likely to engage in environmentally conscientious tendencies towards water use while other studies indicated that education is not a reliable indicator of water-conservation measures. This study showed that most respondents had a positive understanding of efficient usage of water and were aware of water conservation practices.

4.2.4. Occupational level of respondents in Giyani Township

In the context of this study, occupation refers to a person's usual work or business, especially as a means of earning a living (Ferguson & Li, 2018).

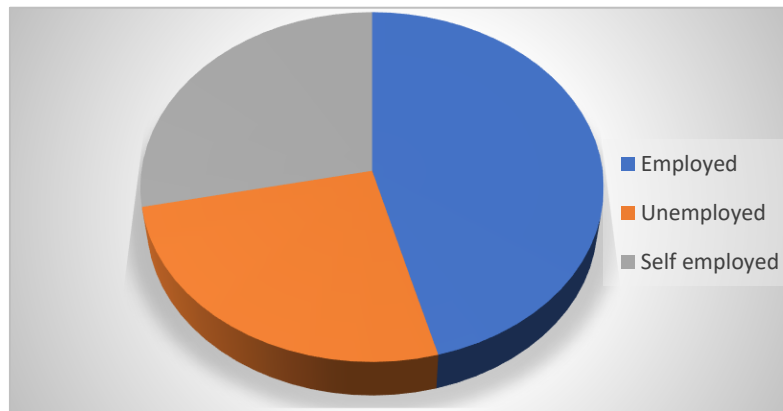


Figure 4.3: Occupational level of respondents in Giyani Township

Giyani Township has a moderate rate of unemployment as indicated in figure 4.3. Most of the respondents were either employed or self-employed. According to the figure 4.4, 26% of the respondents were unemployed, 28% were self-employed and 46% of the respondents were individuals belonging to working class, employed in government sectors some of which required tertiary education such as nursing, teaching, policing and clerical works. Others worked for private organisations while some worked in retail sectors. It appears that education plays a significant role in determining the type of employment a person gets. According to the Greater Giyani Local Municipality's IDP (2017/2018), unemployment has a negative impact on society and might eventually result in an increase in crime, grant dependency, and non-payment of services. Unemployment rate poses a challenge in many households, as many activities that require money such as payment of water services may not be affordable.

4.2.5. Households' monthly income of residents in Giyani Township

Based on the context of this study, household income refers to the total money earned by all people living in a particular household (Li & Wang, 2018).

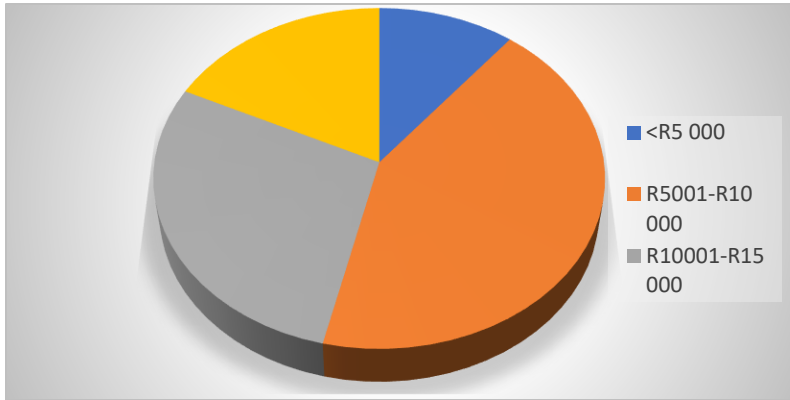


Figure 4.4: Households' monthly income of Giyani Township

In Figure 4.4, 11% of the respondents are shown to have earned an amount of less than R5 000, 43% earned R5 001 to R10 000, 28% of the respondents earned a salary of R10 001 to R15 000 and 18% earned R15 000 and above. The high number of low earning people could be associated with employment in sectors such as agriculture that employs in general more people, but pays very low wages, while people who earn higher incomes are professionals who are usually few in number (Greater Giyani Local Municipality's IDP, 2015/16).

4.2.6. Household sizes in Giyani Township

In the context of this study, household size refers to the average number of people from young to old residing within a particular household (United Nations, Department of Economic and Social Affairs, 2017).

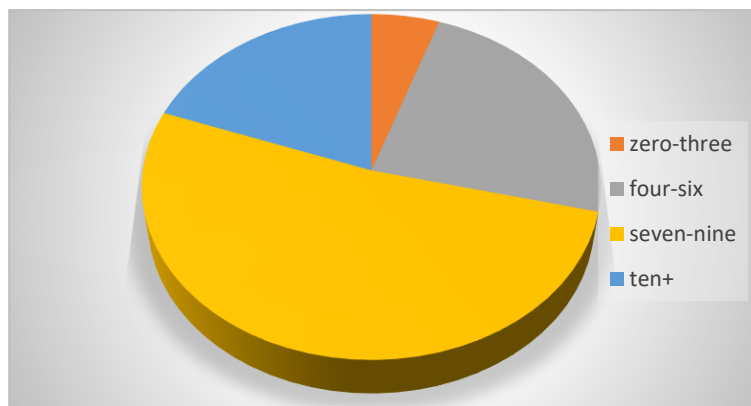


Figure 4.5: Household sizes in Giyani Township

The responses in figure 4.5 indicates that 5% of the respondents were from families of three members and less, 24% of the respondents were from families of four to six members and 52% were from families of seven to nine members. Nineteen percent (19%) of respondents were from families of ten and more. Households in South Africa have an average of 3.4 people per household (South Africa Demographic and Health Survey, 2016). According to figure 4.6, most community members have large families. The reason for large family sizes could be that the grandparents usually take responsibility of raising their grandchildren as the parents are seeking employment in other places, working far from home while others are furthering their studies.

The results of a study by Masangu (2009) on allocation and use of water for domestic and productive purposes in Siyandhani village in Limpopo Province, agree with the findings of this study regarding large family sizes. Masangu’s study revealed that the average number of people per household was six, with a minimum of two people and a maximum of 11 people. In addition, the results of a study by Netshipale (2016) on water services delivery in Mukondeni village in Limpopo Province highlighted that most community members have large families, ranging from 6 to 7 people in each household, other households had 3 to 5 members per family and other households had the largest numbers of 8 to 12 members in the family. A Chi-square test (Table 4.2) established whether there was a relationship between household size and water consumption per day in Giyani Township.

Table 4.2: Household size and water consumption per day in Giyani Township

	Value	Degree of freedom	Significance
Pearson Chi Square	47.381	12	0.05
Likelihood Ratio	23.844	12	0.05
No of Valid Cases	382		

In table 4.2, the Chi-square value (47.381) is greater than the degree of freedom value (21). Hence, there is a relationship between the number of people in a household and the amount of water used in a daily bases. Household size and composition are important factors that influence water usage. This leads to an assumption that the more people are in a household, the higher the chances of more water used and the fewer the people in a household, the lesser the water used.

4.2.7. Participants' period of stay in Giyani Township

Period of stay in this study refers to the number of years a person has lived in a particular place be it by birth or relocation (Longman Dictionary of Contemporary English, 2003).

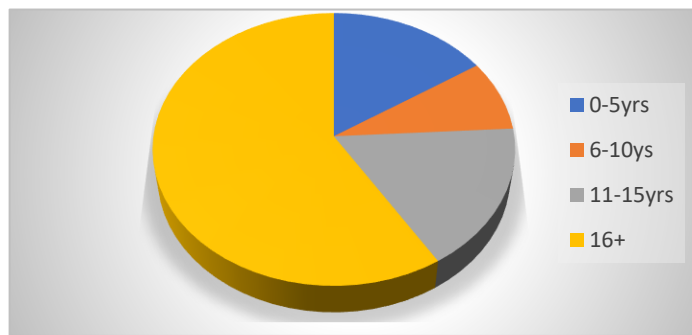


Figure 4.6: Participants' period of stay in Giyani Township

Figure 4.6 shows that 16% of the respondents stayed in the township for a period of five years and less, 8% of the respondents stayed for a period of six to ten years, while 17% stayed for about eleven to fifteen years. A large percentage (59%) of the respondents stayed in the township for a period of 16 years and more. It is important to note that some of the respondents were not permanent but temporary residents who came to seek employment in the township and had consequently affected the use of water.

4.3. Water availability and accessibility in Giyani Township

Water availability in this study refers to the quantity of water used for human consumption purposes without significant harm to ecosystems or other users (Naik, 2016). The factors

such as sources of water, uses of water, frequency of getting water, metering of piped water, average water consumption are causes of seasonal water shortage. In addition, more information about reporting pipe bursts, notification of water cut-offs, time taken to fix reported pipes, who report on service delivery and the rating of water service assisted to obtain information pertaining to water availability and accessibility in Greater Giyani Local Municipality. The respondents were asked whether water was available in Giyani township and as indicated, 26% of the participants said 'Yes' while 74% said 'No'. The responses revealed that water is not always available to all the households. It was therefore, assumed that the major cause of the unavailability of water in the township might be inconsistent. The respondents who indicated that they always have water readily available are those who have installed boreholes and have storage tanks in their yards.

4.3.1. Sources of water in Giyani Township

Source of water in this study refers to surface water such as water from rivers accessed in the form of piped water and underground water obtained by means of boreholes (Hanasaki *et al.*, 2018). There are different ways by which residents of Giyani Township obtain water such as rainwater harvesting and collecting some from nearby Nsami Dam for different uses per household.

Twenty-six percent (26%) of the respondents indicated that they obtain water from private boreholes and 74% said that their source of water is piped water supplied by the Greater Giyani Local Municipality. Water supply should be regular in all communities because it is one of the basic needs. The respondents who obtained water from boreholes hinted that they use both piped water and water from boreholes as a way of reducing their water bills. The households further said that installation of boreholes was a way of guaranteeing continuous supply of water, as there were days on which water from municipal pipelines was not available. A Chi-square test tested whether there was any association between household income and types of water source.

Table 4.3: Association between household income and type of water source

	Value	Degree of freedom	Significance
Pearson Chi-Square	49.766	16	0.05
Likelihood Ratio	47.939	16	0.05
No of Valid Cases	382		

In table 4.3, the Chi-square value (49.766) is greater than the degree of freedom value (12.6), which means that there is a relationship between household income and the type of water source. It is therefore, assumed that the sampled households were at a greater chance of affording the type of water sources they have. According to the respondents, they paid for piped water supplied by the municipality. Payment for private boreholes is an indication that household income played a significant role in the affordability of the type of water source for each household.

4.3.2 Uses of water in Giyani Township

In this study, uses of water refer to the different consumptions of water obtained from surface or underground source and conveyed to the place where it is used (Karimi *et al.*, 2012). In figure 4.9, 10% of the respondents indicated that they use water for both domestic and productive activities whereas, ninety percent (90%) of the respondents highlight that they use water mainly for domestic purposes which includes indoor and outdoor functions such as drinking, preparing food, bathing, washing clothes and watering of gardens. On the other hand, productive water use include activities such as agriculture, gardening, horticulture, livestock-raising, car-washing, ice-making, brick-making, butchery, and other small-scale commercial activities. The results agree with those of Nkwinika's research (2007) on the impact of water shortage on the development of

Mhangweni community in Mhangweni village Limpopo Province. Majority of respondents about (80%) in Mhangweni village indicated that their major use of water was for domestic purposes, while a small number of respondents (20%) indicated that they needed water for other activities such as crop and livestock farming. A Chi-square test (Table 4.4) established if there was any link between water consumption and water use in Giyani Township.

Table 4.4: Association between water consumption and water use in Giyani Township

	Value	Degree of freedom	Significance
Pearson Chi-Square	1.952	4	0.05
Likelihood Ratio	1.948	4	0.05
No of Valid Cases	382		

As indicated in table 4.4, the value of the Chi-square (1.952) is less than the degree of freedom value (9.45), which implies that there is no association between the amount of water used and the uses of water in either domestic or productive activities. Based on the results of this study, the assumption is that the use of water is not dependent on the type of activity. However both the consumption and the type of activity relied on the availability of water.

4.3.3. Frequency of getting water in Giyani Township

Frequency of getting water in this study refers to the regular flow of water in the pipelines making the water obtainable for usage all the time (Drinking Water Inspectorate Guidance Document, 2012). Figure 4.7 shows that 27% of the respondents said that they get water on a continuous 24 hours supply, 26% of the respondents indicated that they get water

once a day while 47% of the respondents said that they get water on every alternative day.

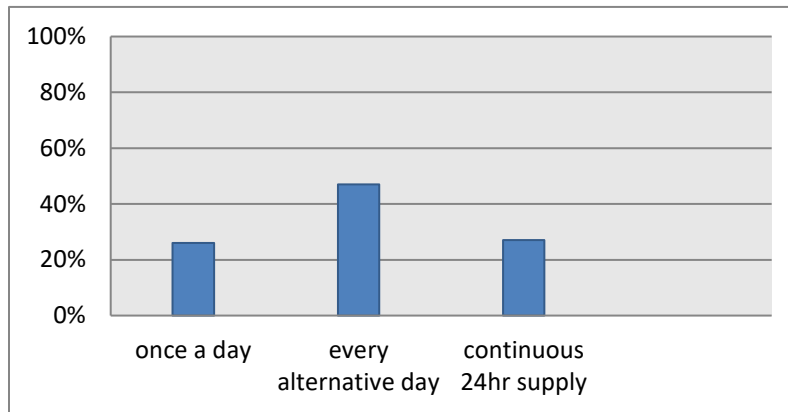


Figure 4.7: Frequency of getting water in Giyani Township

The cause of such irregularity in obtaining water might be associated with the location of households as those who live in low-lying areas stand a chance of getting water on a regular basis than those who stay in high lying areas. It can also be assumed that the high lift water pumps are under pressure of supplying water as the residential area have increased due to population rise. As observed, the frequent breakdowns of the water supply system may also affect the frequency of water. The results concur with those of Dau (2010) in a study on the evaluation of water and sanitation services in Thulamela municipality, which indicated that some residents have consistently flowing taps whilst others do not have water at all times. The findings further highlighted that the pressure of water is usually low, and communities usually spend two to three days without water.

4.3.4. Piped water metering in Giyani Township

In the context of this study piped water metering refers to the process of measuring water use through meter readings which in turn help calculate an amount a household needs to pay for water that is consumed (Taswater, 2015). Thirteen percent (13%) of the respondents had no metres installed in their homes while 87% responded that they had metres installed. The respondents who said 'No' responded in that way because the meters have not been working for a long time, regardless of the number of times the

problem was reported to the municipality. The respondents further indicated that the bills always came out with amounts that could not be understood as to how the amounts were arrived at because of no-meter readings on a monthly basis or meters being out of order. As a result, respondents did not understand how much water is per kilolitre and therefore, felt that the amount charged was not in proportion to the amount of water used. The respondents said that they suspected that those who were supposed to take meter readings forged them at some point, as the municipal representatives did not go from house to house to take readings as per municipal directive.

Surprisingly, the respondents who mentioned that they have water meters installed in their homes could not tell how much does a kiloliter cost. The respondents indicated that the water bills did not show how much the municipality charged per kiloliter for water usage and therefore, the total amount billed as per statement received on a monthly basis was without clarifications. Figure 4.8 outlines the monthly water payments where 27% of the respondents paid R100 for the water bill. Fifty-two percent (52%) paid between R101-R300 per month while twenty-one percent (21%) of the respondents paid R301 and more based on a particular month's usage of water. According to Mavhungu (2011), payment for services is a necessity because providing services without cost recovery, in some instances, has serious implications on the sustainability of services since the municipality becomes unable to recover the cost for providing services.

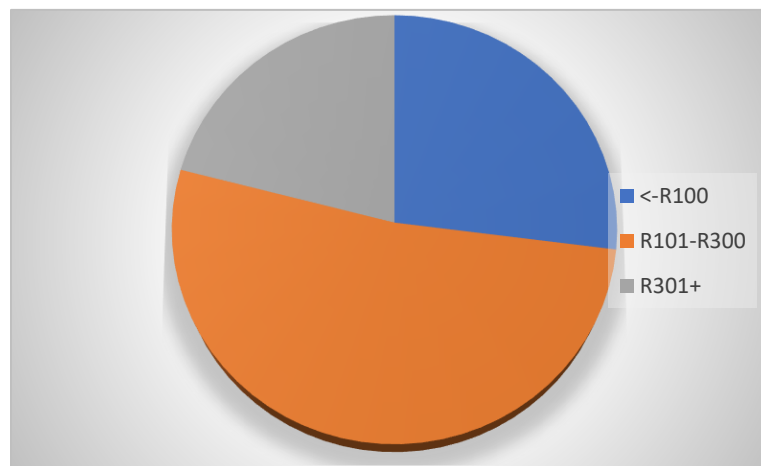


Figure 4.8: Monthly payment of water bills in Giyani Township

A Chi-square test (Table 4.5) established if there was any association between water use and the amount paid.

Table 4.5: Association between water usage and amount paid.

	Value	Degree of freedom	Significance
Pearson Chi-Square	189.801	8	0.05
Likelihood Ratio	196.338	8	0.05
No of Valid Cases	382		

According to the results, the Chi-square value (189.801) is greater than the degree of freedom value (9.45) which means that there is an association between water usage and amount paid. Payment for water use corresponded with an increase in water consumption by households. Jiang & Rohendi (2018) emphasised that households who do not pay bills for water use an average of 19% more water than households who do pay. According to Ramsey *et al.*, (2017), there exist a large body of conflicting literature on impacts of water consumption pricing. In some instances higher water prices correlate with lower water consumption particularly where the focus is on volumetric water pricing while in other instances, prices have little or no influence on overall water consumption because water demands had inconsistent pricing.

4.3.5. Average water consumption per day per household in Giyani Township

Average water consumption in this study refers to the amount of water used daily by different households with an average of 250ℓ per day (Aqaristra, 2010).

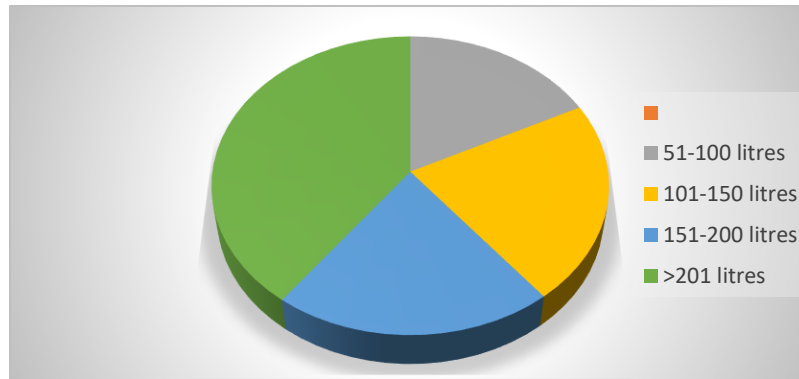


Figure 4.9: Average water consumption per day per household in Giyani Township

Cole *et al.* (2018) stressed that every person should have access to at least 25 liters per day in rural areas and 50 liters per day in urban areas. Figure 4.9 shows that 17% of the respondents said that they used from 51 liters -100 liters whilst 22% indicated that they used around 101 litres-150 liters of water per day. Twenty-one percent (21%) said that they use nearly 151 litres-200 liters of water in their households per day. Forty percent (40%) of the respondents stated that they used 201 liters and more per day.

Amounts of water used for basic needs vary according to quality and proximity of the water supply source and the size and wealth of households (Armah *et al.*, 2018). In some instances, those with a small number of family members happened to be huge consumers of water than those with many family members. However, it is in general, mostly expected that those with many family members happen to be huge consumers of water. The findings of a study by Nkwinika (2007) on the impact of water problems on the development of Mhangweni community in Limpopo Province indicated that about 36% of female respondents mentioned that they needed 6 000 litres of water per month and the remaining 64% needed up to 7 500 litres of water per month. The demand for such large

quantities of water was associated with many domestic activities. Most households of Giyani Township used more liters of water daily because of the different uses of water and the number of people per household.

4.4. Concerns and constraints of water availability in Giyani Township

4.4.1. Seasonal water shortage in Giyani Township

A season in this study is each of the four divisions of the year characterised by weather patterns and daylight hours. The divisions are autumn, winter, spring, and summer. Each period has its own typical weather conditions in different places (The American heritage science dictionary, 2015). There is a link between seasonal water shortage and availability and reliability of rainfall. The rainfall help to fill up rivers and dams to supplement water supply.

Twenty-one percent (21%) of the respondents said that they did not experience any seasonal water shortage while 79% of the respondents mentioned that they experienced seasonal water shortage because the annual rainfall levels in Giyani Township are very low and irregular. The municipal area received between 200ml-400ml of rain annually (IDP, 2015/16). Generally, the municipal area is characterised by low summer rainfalls that result in severe water shortages and drought conditions. A Chi-square test (Table 4.6) checked if there was any association between frequency of water supply and seasonal water shortage.

Table 4.6: Association between frequency of water supply and seasonal water shortage

	Value	Degree of freedom	Significance
Pearson Chi-Square	12.322	4	0.05
Likelihood Ratio	11.638	4	0.05
No of Valid Cases	382		

Table 4.6 shows that the Chi-square value (12.322) is greater than the degree of freedom value (9.45), meaning that there is an association between seasonal water shortages and the frequency of water supply. It is therefore, assumed that when there is less rainfall the sources of water such as Nsami Dam are negatively affected and therefore less water was supplied to households. The results of the Chi-square test indicate that the frequency of water supply depends on seasonal rainfall. The respondents indicated on which months of the year were water shortages experienced. For the respondents to give straightforward answers, the researcher grouped the months into seasons of the year namely: summer, autumn, winter and spring.

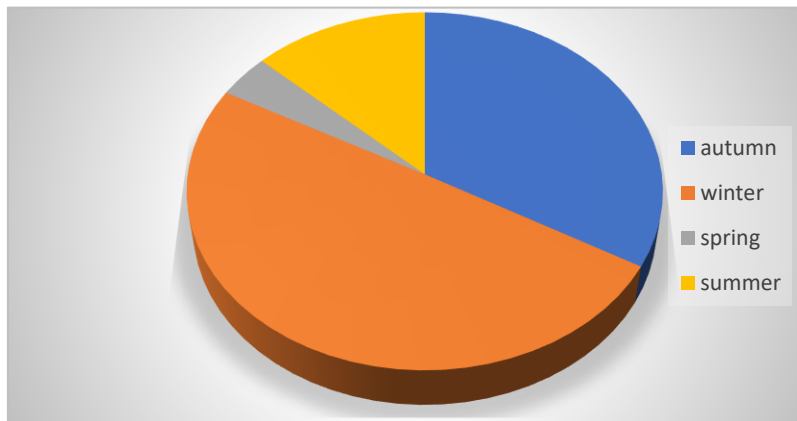


Figure 4.10: Seasons of water shortage in Giyani Township

About 13% of the respondents said that they have a water shortage during summer, while 33% said that they experienced water shortage in autumn. On the other hand, 50% of the respondents said that they experienced water shortage in winter and 4% of the respondents experienced water shortage in spring. Those who said that they experience water shortage in summer mentioned, during summer there are more pipe bursts

The results of a study by Masangu (2009) on allocation and use of water for domestic and productive purposes in Siyandhani village showed that 87% of the respondents mentioned that the amount of water collected for domestic purposes varied seasonally, and the rest said there was no difference in the amount of water collected between

seasons. Some respondents mentioned that they collected less water in summer, while others said that more water is in summer. In her study on challenges of water governance for rural water supply in Nkomazi and Makhado local municipalities, Nkuna (2012) established that despite the water supply infrastructure installed in most places, about thrice a week water was unavailable. Water purification plants as well as reservoirs were in place, however these often had technical problems and as a result, reservoirs were often empty due to insufficient water supply.

4.4.2. Other causes of water shortage in Giyani Township

In the context of this study, water shortage is a situation whereby water sources have unreliable supply for the community due to climate change, population growth or other factors that may lead to unavailability of water for consumption (Chakraborti, 2019). Respondents further indicated views on other causes of water shortage in Giyani Township. The participants of the study identified the following as the additional causes of water shortage.

In general, respondents highlighted that delays in completion of water projects were a negative setback to water availability. In this case, the respondents mentioned two major projects that intended to reduce shortage of water in the area. The first project mentioned was the Giyani bulk water supply and drought relief project initiated in 2010 by the DWS. The respondents indicated that they learnt that the project aimed at constructing concrete reservoirs and a bulk pipeline between Nandoni Dam in Thohoyandou and Nsami water treatment works in Giyani. However, the project was not successful and no official explanation was available according to the respondents.

As observed there were pipes intended for use in the Giyani bulk water supply and drought relief project which were left unused. The unused pipes are still at the observed particular place and up to date, no one knows whether the project will at some time resume or not. One respondent speculated that the delay in the completion of the projects is associate with the mismanagement of funds by the contractors given the tender.

The second project that the respondents identified, as a possible means to solve the problem of water shortage in the area was the upgrading of Giyani water treatment plant that is responsible for supplying water to the township and some villages within the municipal area. In relation to this project, another respondent said that due to corruption related activities, the project is still incomplete but the completed portion has already broken down.

In addition to the incomplete projects, the respondents added the following as other causes of shortage of water:

- Frequent damage of main pipelines caused leakages of water at the valves of the water reticulation systems that often interfered with water supply.
- Illegal connections of water to the nearest villages outside the township affected the normal reticulation of water to the whole township.
- Population growth contributed to the problem of water shortage as the quantity of water supply did not increase with a rise in population numbers.
- Too little rain increases the severity of water shortages that in turn leads to drought conditions.

All these views were the inputs that most respondents shared with the researcher. The results of a study on the causes and effects of water shortage on the households of Ga-Kgapane township by Machete (2011) also indicated that population growth coupled with poor infrastructure that stays the same, broken pipes, less rain, unfair distribution of water to various sections of the township were some of the causes of water shortage in the township.

Although the water projects in the study area failed, there were similar projects that were successful. The Water Wheel (2018) highlighted that a huge project for Shanta Gold mine in Tanzania included fabrication, installation, commissioning of river and skid-mounted borehole treatment package had its completion within the allocated specific timeframe. Nsami Dam is one of the sources of freshwater for the township and according to the

published statistics, DWS (2019), the dam's level had dropped from 46, 8% to 21, 9% resulting in additional stress on water users. Respondents were in addition, asked to indicate when the problem of water shortage started and about 41% of the respondents said that the problem had been going on for a period of five years and more. The respondents (59%) who stayed in the township for a longer period said that the problem could even date up to 15 years ago.

4.4.3. Impact of water shortage in Giyani Township

Twenty-six percent (26%) of the respondents indicated that they were not aware of the shortage of water as they had boreholes, while the remaining 74% experienced some great interruptions in the daily routines of water usage. The affected respondents indicated that when there was insufficient water, some activities stopped until water was available. The respondents further pointed out that the other challenge caused by shortage of water was the malfunctioning of sewerage systems, as they needed large amounts of water to operate. It became worse as majority of households did not have pit latrines or any other alternatives.

The respondents who were engaged in crop farming and livestock-raising activities mentioned that water shortage caused great damage that in turn led to financial loss. The township was consequently, badly affected by the water shortage due to drought. The results of a study conducted by Dau (2010) on the evaluation of the delivery of water and sanitation services in Thulamela municipality indicated that lack of water is a manifestation of poverty and has serious consequences on the livelihood of communities. Dau (2010) further concluded that poor drinking water and sanitation lead to major outbreaks of waterborne diseases that also contribute to high rates of child mortality.

4.4.4. Reporting of pipe bursts in Giyani Township

Reporting of pipe bursts in this study refers to the process of identifying a pipe burst or leakage and then officially reporting it to the responsible authorities (Northern Ireland Water, 2018).

Very few of the respondents (3%) said that they no longer report pipe leaks because they do not get any positive response from the municipality. Ninety-seven percent (97%) of the respondents indicated that when there were pipe leaks in the township, they usually reported the matter to the Greater Giyani local municipality that is responsible for maintenance of the reticulation systems in the township.

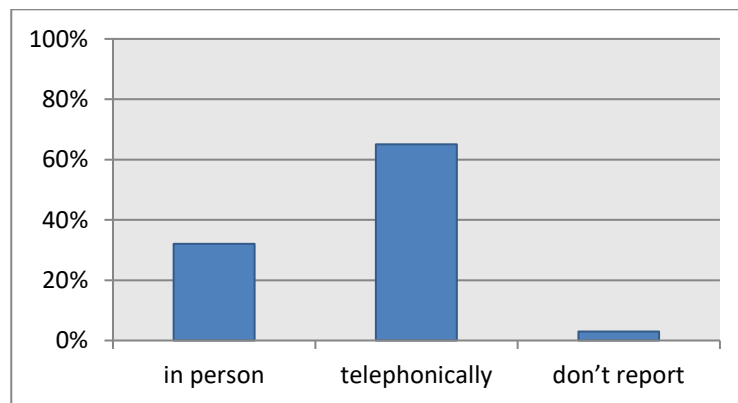


Figure 4.11: Methods of reporting pipe bursts in Giyani Township

In figure 4.11, three percent (3%) of the respondents mentioned that they did not report the pipe leak because of poor responses from the municipality. Thirty-two percent (32%) of the respondents indicated that they reported the pipe bursts in person as they stayed close to the municipal offices and therefore felt that the response would be quicker while 65% said that they reported leakages telephonically in order to save time as the method of reporting was easier for them.

4.4.5. Notification of water cut-offs in Giyani Township

About 19% of the respondents said that there were no notices given for water cut-offs, only dry taps alerted the respondents, while 81% of the respondents said that they received some form of notification through telephone calls or information from different sources such as pamphlets or from other residents before water cut-offs. Furthermore, the respondents indicated that the cut-offs happened on a regular basis without any time frame and that if the cut-offs had a time frame it would have been easier to be prepared beforehand. In any way the respondents associated the water cut-offs with the old infrastructure, regular pipe burst, leaks and high demand of water that is more than the

water supply from the water treatment plant. Low rainfall levels were also contributing factors since the dams and rivers were not able to supply enough water.

In response to the question on methods of notification of water cut-offs, 16% of the respondents got notifications through official notices often displayed at common venues in the township. About 84% of the respondents mentioned that they only got information through word of mouth from fellow community members and it was rare to get formal notices even though the cut-offs had been going on for a very long time.

Through observation and responses from the respondents, it was noted that the solution to the problem of pipe bursts depended on the magnitude of the damage and the place of occurrence. However, in most cases it took about one to two days to solve the problem. The respondents further added that if the damage happened over a weekend, the problem only receive attention the following week as the people who work in the maintenance section did not work over weekends based on the reason that they were not paid for overtime. As a result, water tanks had to deliver water to the affected section

4.4.6. Water service delivery in Giyani Township

In the context of this study, service delivery refers to the distribution of basic resources such as water by government to communities (Chen, 2014). The respondents answered questions on whether their ward councillors gave them feedback regarding service delivery.

About 90% of the respondents indicated that there were no regular feedback and that in most cases the municipality usually attended to water service problems before and during election campaigns and thereafter, no attention given to the community's complaints. The remaining 10% of the respondents mentioned that they did get regular feedback on water service delivery only during community meetings. The results of this study agree with those of a research conducted by Manamela (2010) on an investigation of water delivery constraints in Mabokelele village, which indicated that the ward councillor failed to convene regular meetings to discuss water issues with the community because meeting notices were often not received in time. Such behaviour discourage the community

members to attend meetings through which members can voice the concerns related to water service delivery.

A Chi-square test done helped to check whether there was any association between service delivery and water frequency. The results are in table 4.

Table 4.7: Association between service delivery and water frequency in Giyani Township.

	Value	Degree of freedom	Significance
Pearson Chi-Square	12.891	6	0.05
Likelihood Ratio	12.387	6	0.05
No of Valid Cases	278		

The Chi-square value (12.891) is greater than the degree of freedom value (12.6) Therefore, there is a relationship between service delivery and frequency of water in Giyani Township. Bannister (2011) outlined that water service delivery is a function of actual delivery of water services to consumers. According to the results of the Chi-square test, in this study the rating of service delivery was according to the regularity and frequency of access to water. When water was readily available, the municipality often got a good rating but when there was irregularity in water provision the municipality was associated with poor service delivery.

The respondents were therefore, asked to rate the performance of Greater Giyani Local Municipality in terms of water service delivery. Four percent (4%) of the respondents regarded the municipality as good in terms of water supply services, 25% of the respondents rated the municipality as fair in providing water supply services while 51% rated the municipality as a poor service provider in terms of water supply and 20% rated the water supply services of the municipality as very poor.

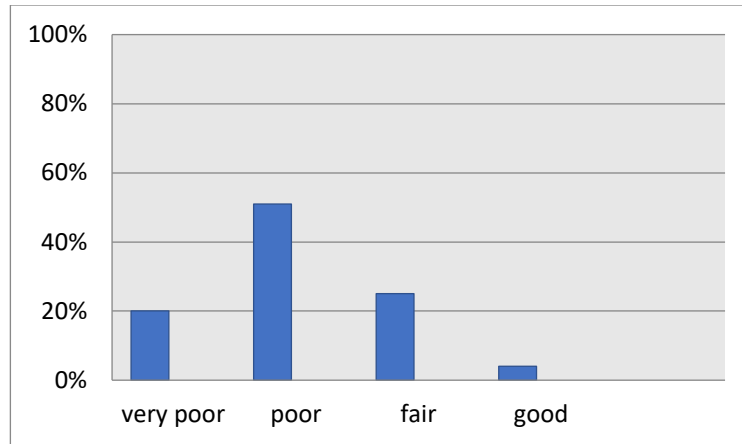


Figure 4.12: Rating of water service delivery in Giyani Township

The results are similar to the findings of a study by Mavhungu (2011) on the non-payment for municipal services in the Vhembe district municipality. In that study only 2% of the respondents rated the services of the municipality as very good, 39% said that the services were good, 36% indicated that the services were poor and 23% rated the services as very poor. The findings further revealed that the high degree of dissatisfaction among consumers about municipal water services delivery had serious implications on revenue collection because unhappy customers are unlikely and unwilling to pay for services as indicated by the respondents of the study. In the opinion of the respondents, the municipality could not prioritise the provision of water because of insufficient funds. Hence, they felt that there should be enough funds to enable the functioning of the current infrastructures responsible for water supply.

Greater Giyani local municipality like other municipalities of Limpopo Province has a mandate to develop and implement an IDP as a way of addressing issues that pertain to service delivery including water supply. In attempting to address the problem of water service delivery, the municipality committed in the IDP (2015/16) to provide 6 kilolitres of free basic piped water to all households of Giyani Township. The researcher established that households within the municipal area use more water than the free basic water rate.

4.5. Challenges encountered by the authorities in the water sector of Giyani Township

Key informant interviews focused more on establishing information about the challenges of water supply constraints. Table 4.8 outlines the key informants interviewed. The choice of the key informants was on the notion that they were familiar with the challenges of water supply constraints as they directly work in the water sector and water service department of the municipality.

Table 4.8: Key informants

Designation
Plant superintendent of Greater Giyani Local Municipality
Process controller
Head of water reticulation services and maintenance Division
Greater Giyani Local Municipality representative

4.5.1. The responses of the key informants' interview are as follows:

4.5.1.1. Plant superintendent of Greater Giyani Local Municipality

The plant superintendent indicated that the mechanical parts of the treatment plants experienced frequent breakdowns and in some instances not all segments of the treatment plant were operational. He mentioned that at some point sedimentation tanks, flash mixer and some filters were not always in good condition and backwashing of filters was not on a regular basis. In addition to the filters that encountered frequent breakdowns, the plant superintendent highlighted the mechanical failures.

The plant superintendent further highlighted that the distribution of water was possible through the division of the main lines from reservoirs, meaning that there was one main line responsible for supplying the township and the other villages. However, illegal connections, bursting of pipes due to ageing and low pressure of water from the reservoir interrupted the supply. Hence, the intended new treatment plant was to boost the carrying capacity of the old plant. Unfortunately, the project was not a success. He added that the regulation of water supply by allowing provision of water at certain time intervals, every individual would get water, as congestion could be controlled and avoided despite the challenges.

The plant superintendent also highlighted that there was shortage of staff and mentioned that if the municipality could increase the budget on water provision it could also help in employing more skilled workers. He further suggested the prioritisation of consultants to run maintenance related issues, to reduce or do away with the norm of not replacing or buying new equipment for the municipality. He also pointed out that the municipality should allow plant superintendents at different stations to be independent and have their own budget to assist in times of crisis.

4.5.1.2. Process controller of Giyani Local Municipality water supply services

The process controller's interview was about the operation and water supply section of the water treatment plant. According to him, one of the challenges sometimes encountered during operation was the shortage of chemicals such as chlorine used for disinfection of water. The process controller indicated that the procedure of processing payments to the suppliers was very long and it did not have a fixed period. Hence, the delivery of chemicals was a challenge. "However, we ensured that, water which is discharged to people was disinfected by borrowing the required amount of chemicals from other treatment plants until we received our order and if we did not get any help the plant was closed down": said the process controller.

4.5.1.3. Head of water reticulation services and maintenance division in Giyani Local Municipality

The head of water reticulation services and maintenance division responded to questions related to maintenance of the water reticulation systems. The duties included managing the maintenance of both surface and groundwater infrastructures daily. He indicated that the community members reported most of the breakdowns while the ward councillors reported some. The head of water reticulation services and maintenance division further highlighted that reported cases received immediate attention. Some of the challenges encountered were vandalism of infrastructure that needed money to repair or replace the system.

The head of water reticulation services and maintenance division also pointed out that population growth challenged water supply while ageing of infrastructure contributed to frequent breakdowns. He further mentioned that the issue of budget not being transparent makes planning for long term solutions difficult and that there is shortage of young staff as most of the employees are at retirement age. He then as part of the solution suggested that the municipality should employ young people, always provide equipment and tools, fully disclose budget and continue to encourage awareness campaigns on water-saving strategies in all communities.

4.5.1.4. Greater Giyani Local Municipality representative

The Greater Giyani Local Municipality representative explained that the municipality is a water service provider and is therefore responsible for providing basic water service management such as billing, collection and recording of water and sanitation revenue.

The representative further explained that the Mopani District Municipality is the water service authority. The local and the district municipalities shared the roles of maintenance of the infrastructure. Greater Giyani Local Municipality supervised the water reticulation systems and Mopani District Municipality controlled the main lines. The representative indicated that on days when there was no water, water tankers supplied water on a rotation system and boreholes supplied water as part of the solution.

He further highlighted that ageing of infrastructure, frequent breakdowns and irregular monitoring of the pipelines disturbed the frequent water supply. The Greater Giyani Local Municipality representative further stated that there was a ministerial intervention that assisted with the building of new lines and new 54 boreholes as 80% of the existing boreholes was not operational. In addition, the upgrading of the water treatment plant remained incomplete even by the set date. He mentioned that Lepelle Northern Water Board was responsible to assist with breakdowns in the township and to supervise a company called Khathu Civils that dealt with main pipelines to the villages surrounding Giyani Township. However, due to financial problems and lack of financial support from DWS, Khathu Civils stopped working on the breakdowns in the township. The municipal representative believed that if the municipality could encourage a commission on water pipelines, water reticulation could be done with ease.

4.6. Summary of the chapter

This chapter presented the research findings and discussions thereof. Several variables that led to water constraints in Giyani Township, such as demographic characteristics of respondents, water availability and accessibility, seasonal water shortage, causes of water shortage, impact of water shortage and water service delivery were looked into and discussed as per analytical methods. In the next chapter, summary, conclusions, recommendations, and identification of areas of future research related to this research are key issues.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The study assessed causes of water supply constraints in Giyani Township in the Greater Giyani Local Municipality, with the hope of finding feasible ways to improve supply of water in the township in a sustainable manner. It is therefore, the aim of this chapter to provide the summary of findings of the study. The sections of this chapter are therefore as follows: introduction, summary of results, conclusions, recommendations, and general conclusion. The conclusions and recommendations drawn relate to the objectives of the study. The findings and conclusions of the study help to formulate recommendations that might be useful to future related studies.

5.2. Summary of the results

The results are summarised under the following themes: demographic characteristics of the respondents, water availability and accessibility. The results of the Key informants' interviews are also summarised. Demographic characteristics in the study include age, gender, educational level and occupation of the respondents. Household size and participants' period of stay in Giyani Township are important issues that relate to water availability and accessibility, which comprise of aspects such as source of water, uses of water, frequency in getting water, metered pipe water, average water consumption and causes of seasonal water shortage. In addition, the respondents supplied information about reporting pipe bursts, notification of water cut-offs, how long it takes to fix reported pipes, who report on water service delivery and the rating of water service in Greater Giyani Local Municipality.

5.2.1. Demographic characteristics.

The age group 50 to 59 years is the largest while the 18 to 28 years age group is the smallest among the respondents in this study. There are more male participants than females in this study and the Chi-square results show that there is no association between gender and water use. This implies that each gender stands a chance of using the same quantity of water as the other. A larger number of the respondents have tertiary education because of the respondents' affordability to enrol in institutions of higher learning. It is evident that education plays a significant role in determining the type of employment, as most respondents are working class individuals with tertiary education. The high number of low earning people are associated with employment in industries and agriculture while a few professionals earn higher incomes.

Most community members have large families because majority of grandparents help to raise grandchildren whose parents are working far from home or are committed in studies. In Giyani Township there is a relationship between the number of people in a household and daily water usage which lead to an understanding that the more people are in a household, the higher the chances of more water used and the fewer the people in a household the lesser the water used. Most of the respondents have stayed in the township for a period of 16 years and more. There are however some respondents who are temporary residents of Giyani Township who came to seek employment.

5.2.2. Water availability and accessibility

Most of the respondents have piped water supplied by the Greater Giyani Local Municipality and very few of them obtain water from private boreholes. In Giyani Township, there is a relationship between household income and type of water source. Few respondents use water for both domestic and productive activities whereas most of the respondents use water mainly for domestic purposes. Water is not always available to all the households. The respondents who indicated that they always have water readily available are those who have installed boreholes and have storage tanks in their yards. A large group of the respondents get water once a day, while a larger group get water on

a continuous 24-hour supply and the largest group of the respondents get water on every alternative day. Most of the respondents use 151-200 liters of water or more daily.

Meters that are so often out of order hinder meter readings monthly. Hence, the bills always show amounts that cause challenges in trying to understand the calculations. This points to the fact that there is no association between water usage and amount paid. This implies that payment for one's water use did not correspond with the water consumption by households

5.2.3. Concerns and constraints for water availability in Giyani Township

Most respondents experience seasonal water shortage in winter and those who experience water shortage in summer is because of pipe bursts. Therefore, there is an association between seasonal water shortages and the frequency of water supply. Delays in the completion of the two water projects which intended to reduce the shortage of water in the area impacted water availability negatively. Shortage of water has several impacts such as domestic activities that must be limited until water is available. The malfunctioning of sewerage systems is of huge concern, as majority of households do not have pit toilets or any other alternatives. Water shortage leads to financial loss to respondents engaged in crop and livestock farming activities.

Some of the respondents no longer report pipe leaks because of the poor response from the municipality. Hence, a larger group report leakages telephonically as a matter of urgency in order to save time as the process of reporting becomes easier for them. The cut-offs of water happen regularly without any time frame although some respondents do receive notification in the form of phone calls or notices from different sources in advance while some are only alerted by dry taps. Some respondents get notifications through official notices often displayed at common venues within the township while most respondents get information through word of mouth from fellow community members because it is rare to get formal notices.

On the other hand, no regular feedback was given on water service delivery to most of the community members as only few members get regular feedbacks on water service delivery except at community meetings. There is a relationship between service delivery and regularity of water supply in Giyani Township meaning that service delivery is a measure of the regularity and frequency of accessing water. When water is readily available, the municipality often receives a good rating than when there is irregularity of water provision where the municipality becomes a poor service provider in terms of water supply services.

5.2.4. Challenges encountered by the authorities in the water sector

Ageing of water infrastructure coupled with high population growth contribute to frequent breakdowns that interfere with regular water supply. Irregular maintenance of pipelines leads to regular burst during heavy rains. Illegal connections on pipelines render the water supply systems vulnerable to frequent breakdowns. Shortage of knowledgeable staff to operate the water supply systems affects the water supply in the Greater Giyani Local Municipality. In addition, the long and unstable procedure for processing payments for chemical supplies delays the delivery of chemicals and other equipment needed for maintenance purposes. Hidden budget hinder water officials to do proper planning for operations and sustainable maintenance and reliable water service delivery.

5.3. Conclusions

The study arrived at the following conclusions:

- Gender has no influence on water use because each gender stands a chance to use the same quantity of water.
- Education is an important factor that influences an understanding for water conservation practices and efficient water use. Education also plays a role in determining the type of employment a person might get in Giyani Township.

- The type of employment influences the salary level of an individual to be either low or high.
- The large family sizes imply that there is a higher chance of using more water. Most respondents are permanent residence of Giyani Township and have experience on water supply constraints.
- Many households in Giyani Township rely on piped water supplied by the Greater Giyani Local Municipality and only few houses have installed
- Boreholes within their yards to have sustainable water supply, as water is not always readily available from the municipality.
- In Greater Giyani Local Municipality, water is used for both domestic and productive activities.
- There is no regular flow of water in Giyani Township as the majority of people do not get a continuous 24 hours supply of water.
- Greater Giyani Local Municipality has a challenge of issuing correct bills due to non-meter readings, which encourages the spirit of non-payment for water services by some community members.
- A high usage of water of about 151-200 liters daily is likely to lead to wastage of water.
- The unreliable and seasonal low rainfall has a direct effect on the sources of water.
- The delay in the completion of two water projects in Giyani Township has put the municipality under intensive pressure in terms of rendering efficient water services to the communities.
- Water shortage has a direct effect on the daily activities of households, crop and livestock farming.
- Pipe leakages are very common in Giyani Township and this tends to disrupt the supply of water.
- There is lack of communication between the Greater Giyani Local Municipality and the community regarding water cut-offs and feedbacks on water service delivery.
- Lack of regular maintenance of pipelines and ageing infrastructure disrupt the regular supply of water.

- The system in place for processing payment for service providers responsible for delivery of chemicals and some essential equipment is unreliable. Processing of payment need to be transparent to the stakeholders to facilitate payments and purchase.
- Lack of disclosure of budget for operation and maintenance affect planning and water service delivery negatively. This is true because processes of preparing activities for the year are delayed. Hence the question of budget need to addressed at the end of the previous year

5.4. Recommendations

Based on the evidence and conclusions drawn from the study, the challenge of water service delivery has been ongoing in Giyani Township. Concrete interventions are therefore, needed to help solve the issue of irregular water supply. The following are recommendations to assist in the realisation of efficient provision of water supply in Giyani Township.

- Installation of community boreholes be a priority in the Greater Giyani Local Municipality to ensure a continuous water supply or to act as alternative means of water supply when existing sources of water run low.
- To encourage the spirit of willingness to pay for water services by the community members and to discourage illegal connections of water, the Greater Giyani Local Municipality should install prepaid meters in houses. These meters need regular reading and maintenance to avoid fault that might lead to incorrect billing.
- Those who do not pay for water services should be penalised by fines in the form of extra payment to ensure a sustainable reliable water supply system.
- Community forums that deal with water conservation must be established and operate on a permanent basis to speed up the process of spreading resolutions taken at meetings about the importance of saving water.
- To minimise delays in completion of water projects within the Greater Giyani Local municipality, reliable people with adequate expertise are to take the tender to ensure a smooth running and a timeous completion of projects.

- The Greater Giyani Local Municipality needs to draft policies and implementation strategies that will encourage the process of community participation, by making information on water service delivery available.
- The municipality should enhance a positive relationship by circulating information and give regular feedbacks on issues concerning communities' needs in time to avoid unnecessary violent strikes and vandalism of resources.
- Greater Giyani Local Municipality and the municipal department of water services should ensure that a plan for regular maintenance of the water supply infrastructure is developed and adhered to regularly by all stakeholders. This means resources such as pipes, chemicals and valves need to be readily available so as not to compromise water supply.
- The budgets allocated by the Greater Giyani Local Municipality for different tasks such as operation and maintenance need to be transparent and accounted for, with strict measures enforced to ensure that the money is used efficiently for the right purpose.

5.5. Conclusion

The purpose of this study was to investigate water supply constraints in Giyani Township, Limpopo Province. The study revealed that there is no permanent alternative means of water supply such as boreholes in Giyani Township while the current water supply system is unable to supply water due to various reasons such as pipe bursts and other technicalities. Water tankers used as back-ups are not able to meet the required amount, as there are many uses of water per household. The study revealed that the municipality rarely distribute vital information through proper communication channels and that result in misunderstandings between the municipality and residents.

The delay in completion of projects suggests that there is a gap in proper planning, distribution of budget and an inconsistency management style in the water sector. Maintenance and repair of old equipment not done on a regular basis and a lack of transparency of budget allocated for water services disrupt water supply. This dissertation affirms that further studies in the field of water service delivery such as maintaining a sustainable water distribution system are required to cap the constraints

that lead to water unavailability and inaccessibility in Giyani Township. Furthermore, to solve the problems of water service in Giyani Township, the municipality should implement the recommendations made by the respondents, the key informants and the researcher.

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APPENDICES

Appendix 1: Turfloop Research Ethics Committee Clearance Certificate (TREC)



University of Limpopo
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**TURFLOOP RESEARCH ETHICS
COMMITTEE CLEARANCE CERTIFICATE**

MEETING: 06 April 2018

PROJECT NUMBER: TREC/41/2018: PG

PROJECT:

Title: An Investigation of Water Supply Constraints in Giyani Township, Greater Giyani Local Municipality, Mopani District, Limpopo Province.

Researcher: RMSS Ramadapa
Supervisor: Dr MJ Mashaba
Co-Supervisors: Mrs JM Letsoalo
School: School of Agricultural and Environmental Sciences
Degree: Master of Science in Geography


PROF. TAB MASHEGO
CHAIRPERSON: TURFLOOP RESEARCH ETHICS COMMITTEE

The Turfloop Research Ethics Committee (TREC) is registered with the National Health Research Ethics Council, Registration Number: REC-0310111-031

- Note:**
- i) Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee.
 - ii) The budget for the research will be considered separately from the protocol. PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.

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Appendix 2: Observation checklist

AN INVESTIGATION ON WATER SUPPLY CONSTRAINTS IN GIYANI TOWNSHIP,
GREATER GIYANI LOCAL MUNICIPALITY, MOPANI DISTRICT, LIMPOPO
PROVINCE.

1. Physical observation of water infrastructure

	YES	NO
1.1. Is water infrastructure working properly?		
1.2. Are households water connections properly maintained?		
1.3. Are yard taps working?		
1.4. Are communal taps/ standpipes in good condition?		
1.5. Is the water reservoir functional?		
1.6 .Are there any additional storage tanks?		
1.7. Are boreholes available and functional?		
1.8. Are pipelines in good condition?		
1.9. Is there any visibility of leaking pipe?		
1.10. Are all segments of the water purification plant working and are in good condition?		

Appendix 3 (a): Questionnaire

QUESTIONNAIRE

AN INVESTIGATION OF WATER SUPPLY CONSTRAINTS IN GIYANI TOWNSHIP,
GREATER GIYANI LOCAL MUNICIPALITY, MOPANI DISTRICT, LIMPOPO
PROVINCE.

My name is Relebogile Ramadapa. I am doing a Master's Degree of Science in Geography at the University of Limpopo. The title of the study is **“an investigation of water supply constraints in Giyani Township, Greater Giyani Local Municipality, Mopani district, Limpopo Province.** I hereby request your participation as the study's success relies on your valuable contribution. All the information provided will be treated as strictly confidential and for academic purpose only.

SECTION A: Demographic characteristics

1.1. Age

18-28	29-39	40-49	50-59	60+
-------	-------	-------	-------	-----

1.2. Gender

Male	Female
------	--------

1.3. Educational level

None	Primary	Secondary	Tertiary
------	---------	-----------	----------

1.4. Occupation

.....

1.5. Household monthly income

≤R 5000	R5001-R10000	R10001-R15000	>R15000
---------	--------------	---------------	---------

1.6. Number of household members

0 - 3	4 – 6	7 – 9	10 +
-------	-------	-------	------

1.7. For how long have you been staying in Giyani Township?

0-5 years	6-10 years	11-15 years	16 + years
-----------	------------	-------------	------------

SECTION B: Water availability/accessibility

2.1. What is your source of water?

Private stand pipe	Private boreholes	Other people's private taps	Water tanker	Piped water
--------------------	-------------------	-----------------------------	--------------	-------------

2.2. Is water always available in your source?

Yes	No
-----	----

2.3. On average, how frequently do you get water?

Every alternative day	Once a day	Twice a day	Continuous 24hr supply
-----------------------	------------	-------------	------------------------

2.4. Is your piped water metered?

Yes	No
-----	----

2.5. If yes, how much do you pay per kiloliter of water?

.....

2.6. If no, how much do you pay per month..... or /day?.....

2.7. What do you use water for?

.....

2.8. What is the average water consumption for the household per day?

30-50 liters	51-100 liters	101-150 liters	151-200 liters	>201 liters
--------------	---------------	----------------	----------------	-------------

2.9. Do you experience seasonal water shortages during the year?

Yes	No
-----	----

2.10. If yes, during which months of the year is the shortage?

Jan- March	April- June	July-Sept	Oct- Dec
------------	-------------	-----------	----------

2.11. What do you think is the cause of water shortage in the township?

.....

2.12. When did the water shortage start?

.....

2.13. How does the water shortage affect you?

.....

.....

2.14. How do you report pipe bursts/ leakages?

In person	In writing	Telephonically
-----------	------------	----------------

2.15. To whom do you report pipe bursts?

.....

2.16. Are you notified before any major water supply systems are fixed?

Yes	No
-----	----

2.17. How long does it normally take for the problem to be solved?

.....

2.18. How are you notified about maintenance of water supply systems?

Word of mouth	Official notices	Community radio station	Other
---------------	------------------	-------------------------	-------

2.19. Do ward councilors report back on service delivery to members of the community?

.....

2.20. How do you rate the performance of Giyani Local Municipality in relation to water service delivery?

Very poor	Poor	Fair	Good	Excellent
-----------	------	------	------	-----------

2.21. What do you think could be done to overcome water supply constraints in Giyani Township?

.....

Thank you very much for your time and participation.

Appendix 3(b): Translated questionnaire

QUESTIONNAIRE

Ndzavisiso wa swiphiqo mayelana na mphakelo wa mati ka doropa ntsongo e mutini wa Giyani lowu nga hansi ka masepala wa Greater Giyani e hansi ka xifundza ntsongo xa Mopani lexi ngale hansi ka xi fundza nkulu xa Limpopo.

Vito ra mina himina Relebogile Ramadapa. Ni endla degree ya Masters ya science ya swa ntivo mbango e Yunivhesiti ya Limpopo. Nhloko mhaka ya projeke I ndzavisiso wa swiphiqo mayelana na mphakelo wa mati ka doropa ntsongo/ e mutini wa Giyani lowu nga hansi ka masepala wa Greater Giyani e hansi ka xifundza ntsongo xa Mopani lexi ngale hansi ka xi fundza nkulu xa Limpopo. Ni tile ku ta endla xikombelo xa le swaku mi va na xiave kumbe ku hoxa xandla eka ndzavisiso lowu. Xi vangelo nkulu kuri leswaku ku humelela ka ndzavisiso lowu swi nga fikeleriwa hinseketelo wa nwina. Ti mhaka hinkwato leti ti nga ta humesiwa hiko kwalaho ka ndzavisio lowu, tita tiyisisiwa leswaku ti tshama tiri xihundla no tirhisiwa ka swa ti dyondzo tale henhla ntsena.

Xiyenge xa A

1.1. Malembe

18-28	29-39	40-49	50-59	60+
-------	-------	-------	-------	-----

1.2. Rimbewu

Xinuna	Xisati
--------	--------

1.3. Dyondzo

Ku hava	Dyondzo ya xikolo xale hansi	Dyondzo ya Xikolo xa le henhla	Dyondzo yale henhla
---------	------------------------------	--------------------------------	---------------------

1.4. Ntirho

.....

1.5. Muholo wa ndyangu hi nhweti.

≤R 5000	R5001-R10000	R10001-R15000	>R15000
---------	--------------	---------------	---------

1.6. Ntsengo wa va ndyangu.

0 - 3	4 – 6	7 – 9	10 +
-------	-------	-------	------

1.7. Mina malembe manghani mikarhi mi tshama la Giyani?

0-5 malembe	6-10 malembe	11-15 malembe	16 + malembe
-------------	--------------	---------------	--------------

Xiyenge xa B: Nkavelo wa mati

2. 1. Mati ya nwina ya huma kwini/ ya sukela kwini?

Pompi yo yima endyangwini	Borhweni yale kaya	Ti pompini ta va ngwana	Movha wo rwala mati	Mati ya le pompini
---------------------------	--------------------	-------------------------	---------------------	--------------------

2.2. Xana mi tirhisa mati ku endla yini?

.....

2.3. Xana mati ya tshama ya rikona?

Ina	Ee
-----	----

2.4. Eka mpimanyeto wale xikarhi, mingava mi kuma mati hinkarhi lowu nga heteki mbilu?

Nkarhi wungwana na wungwana lowu nga kombiwangiki lahawa.	Kangwe hi siku	Kambirhi hi siku	Vusiku na nhlekane
-----------------------------------------------------------	----------------	------------------	--------------------

2.5. Xana mati ya le pompini ya ngwina ya hoxiwe di mitara?

Ina	Ee
-----	----

2.6. Loko kuri ku hi swona, xana mingava mi hakela mali yo tani hi kwini hi kilolitre?

.....

2.7. Loko kuri ku ee, mi hakela mali muni?

Hi masiku	Hi mavhiki	Hi ngweti
-----------	------------	-----------

2.8. Xana ndzinganelo wale xikarhi wa matirhiselo ya mati ya ndyangu wu ngavha wu tani hi kwini hi siku?

30-50 litara	51-100 litara	101-150 litara	151-200 litara	>201 litara
--------------	---------------	----------------	----------------	-------------

2.9. Xana mingava mi hlangavetana na ku pfumaleka ka mati eka ti nguva ti nwana hi lembe?

Ina	ee
-----	----

2.10. Loko kuri ku hi swona,swi tale ku humelela hi ti nweti tini ta lembe?

Jan- March	April- June	July-Sept	Oct- Dec
------------	-------------	-----------	----------

2.11. Xana mi hleketa kuri ku pfumaleka ka mati swi ngava swi endian hi yini?

.....

2.12. Xana ku pfumaleka ka mati swi ngava swi sungule rini e Giyani Township?

.....

2.13. Xana ku pfumaleka ka mati swi mi khumba hi ndlela yini?

.....
.....
2.14. Ku buluka ka ti phaipe to fambisa mati mi swi vika kwini?

.....
2.15. Ma vikelo ya kona yo pfuta/buluka ka ti phaipe ya endlisiwa ku yini?

Hi nomu	Ku tsariwa	Hi rinqingo	Ku tshamiwa hi swona
---------	------------	-------------	----------------------

2.16. Xana ma tivisiwa loko kutava na ku pfariwa kumbe ku pfumaleka ka mati?

Ina	Ee
-----	----

2.17. Xana mi vikeriwa hi ndlela yini loko ku rina ku pfumaleka ka mati?

Hi nomu	Xiviko xa ximfumo	Xiyanimoya xa muganga	Hi ti ndlela ti ngwana
---------	-------------------	-----------------------	------------------------

2.18. Xana swi ngava swi teka nkarhi wo tani hi kwini ku lulamisa swi phiqo swo tani?

.....
2.19. Xana vomu khanselara vona vangava va vika swi viko swa vukorokeri eka va aka tiko?

.....
2.20. Xana minga pimanyeta matirhelo ya masepala wa Giyani loko swita ka vukorokeri bya mati?

A swi vuleki	A swi amukeleki	Swo ringanela	Swi kahle	Swi kahle swinene
--------------	-----------------	---------------	-----------	-------------------

2.21. Xana mi hleketa ku incini xinga endliwaku ku lulamisa swi phiqo swa nkavelo wa mati e Giyani?

.....

Hi khensa swinene nkarhi na ku ti karhata ka nwina ku hoxa xandla eka ndzavisiso lowu.

Appendix 4: Letter of consent

P O Box 150

Sekgopo

0802

Dear Participant

Request of your participation in the research project/study

I, Sibuyi R.M.S.S, hereby request your participation in the research study that concerns water service delivery in Giyani Township within Greater Giyani Local Municipality.

I am a student at the University of Limpopo studying for the degree Master of Science. During the progression of the research project I will modestly request you to assist me in providing information through interviews. During these interviews, your rights will be respected. Confidentiality, privacy and anonymity will be maintained. The source of information will not be disclosed to anyone without your permission. Your right to withdraw from interview at any stage will be respected.

I..... declare that I am a participant in this research project.

Signature:..... Date:.....

Appendix 5: Consent to participate in this study

Title: An investigation of water supply constraints in Giyani Township, Greater Giyani local municipality, Mopani district, Limpopo Province.

I..... (Participant's name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to participate by responding to the questionnaire and any other question that may arise for further clarity.

I have received a signed copy of the informed consent agreement.

Participant Name & Surname..... (Please print)

Participant Signature..... Date.....

Researcher's Name & Surname: Mrs Relebogile Sandra Ramadapa

Researcher's Signature.....