INTERVENTION STRATEGY FOR EFFECTIVE POTABLE WATER SUPPLY SYSTEM TO RURAL COMMUNITIES IN VHEMBE DISTRICT MUNICIPALITY, SOUTH AFRICA

BY

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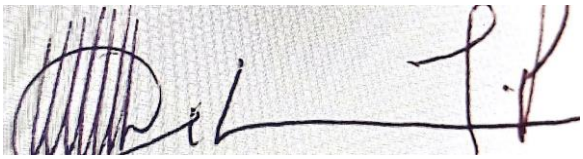
DECLARATION

I, Tuwani Petrus Malima, hereby declare that this thesis for the Doctor of Philosophy Degree in Rural Development (PhDRDV) submitted, to the Institute for Rural Development, in the School of Agriculture, at the University of Venda has not been submitted previously for any degree at this or another university. It is original in design and in execution, and all reference material contained therein have been duly acknowledged.



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Tuwani Petrus Malima

ABSTRACT

Potable water supply is a fundamental human right and protected by international conventions and national laws. Access to it and having in place an appropriate water supply system remain the building blocks to improving and maintaining the welfare of any community for it to enjoy a healthy and productive life. The supply of potable water, especially in Africa's rural areas, however, remains a challenge. The demand for a system to provide sustainable water supply has been on the increase due to population growth and the climate change phenomenon. Vhembe District Municipality (VDM), as the responsible authority for water supply in sections of the Limpopo Province, faces many challenges, including - aging water supply infrastructure, lack of capacity of officials, and lack of funds for maintenance; these often lead to a breakdown of the supply system. This challenge results, for example, in increased health hazards that often cause tension between the District and the residents. The study's main objective was to investigate the water supply system in Vhembe so as to suggest an effective intervention strategy for potable rural water supply system to improve the supply in the Vhembe District Municipality of the Limpopo Province. The specific objectives were - to determine the current potable water supply sources in rural communities of the VDM, examine the system's ability to meet the needs of the rural communities in VDM and to identify the challenges and coping strategies used to meet potable water supply in VDM.

A mixed-method, of both qualitative and quantitative research designs and techniques, was adopted and focus group discussions and in-depth interviews were used to gather data. From the four local municipalities of VDM, 14 wards were purposively selected through proportional representation of 448 households, which were randomly selected. Three municipal officials responsible for the water supply system in the VDM were selected through census. Key-informant discussions were held with councillors from the 14 wards, with focus group discussions used to engage the 448 households, and traditional leaders. Thematic content analysis was used to identify common themes, ideas, and patterns of meaning that came up frequently from qualitative data. The IBM Statistical Package for the Social Science (SPSS) version 25 was used to analyse data using descriptive statistics, one way ANOVA and Chi-Square test.The results revealed that in Vhembe District Municipality, the primary sources of water were boreholes (45.3%) followed by piped water from the dams (35.3%). The majority of the households (53.6%) obtain water from boreholes once per week, with 4% resorting to obtaining water from rivers, 5.4% obtained water from fountains and 10% obtained their water from Municipality water tankers (truck tankers). These results indicate that the District continues to face challeges in its efforts to fulfill its mandate as the responsible authority for water supply, in the rural communities due to lack of a sustainable system to supply the required minimum water needs for households. The study recommended that all stakeholders should join hands to invest in a system that has more water supply options to sustainably meet the needs of the growing population. The system should have management

structures relevant for villages, as critical pillars to assist - with the management system, address minor maintenance requirements, and monitor and report any water supply system-related issues. It was also suggested that rural communities be encouraged to pay for water supply services, for the system's sustainability and that the system in VDM would be improved when stakeholders (communities, government, and NGOs) come together.

Key words: Potable Water, Portable Water Supply, Effectiveness, Vhembe District Municipality, Rural area**.**

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ABBREVIATIONS AND ACRONYMS

ADB	African Development Bank
AWARD	Association for Water and Rural Development
CATS	Community Approach to Total Sanitation
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
ECA	Economic Commission of Africa
FBSP	Free Basic Services Policy
HRC	Human Rights Commission
IDP	Integrated Development Plan
NDP	National Development Plan
NGO	Non-Governmental Organization
PAHO	Pan American Health Organization
SDG	Sustainable Development Goals
STATSSA	Statistics South Africa
SPSS	Statistical Package for Social Sciences
UN	United Nations
UNDP	United Nations Development Plan
UNGA	United Nations General Assembly
UNICEF	United Nations International Children Education Funds
USD	United States Dollar
VDM	Vhembe District Municipality
WDSA	Water Dialogues South Africa
WHO	World Health Organisation

CHAPTER 1: INTRODUCTION

1.1. Background

Potable water supply is a fundamental human right protected by international conventions and national laws (World Health Organization (WHO), 2014), hence, water provision should be sustainable and effective (United Nations International Children's Fund (UNICEF) and WHO, 2012). Potable water as a human right, means that no one should be denied access to it. This is the reason WHO (2014) affirmed that water rights should be closely linked to the right to an adequate standard of living, mental health, life, and human dignity.

According to UNICEF and WHO (2012), the global target to enable 2 billion people have access to potable water, has not yet been achieved. Globally, the demand for potable water supply has increased, due to a combination of global population explosion and droughts. About 65% of rural households, throughout the world, do not have access to adequate supply of water (UNICEF and WHO, 2012). This challenge is often blamed on poor government policies in addressing rural households water issues, from an informed point of view. The United Nations General Assembly (2015), came up with Sustainable Development Goal (SDGs) number six, to cover universal access to, and the improvement of water quality, effective use of water, and support for rural communities to achieve this. Furthermore, the General Assembly noted the need for strengthening the participation of local communities in improving water management, therefore, globally there is a committment to ensure the availability and sustainable management of potable water and sanitation for all by 2030. In addition, this goal ensures support to strengthen the participation of local communities in programmes to improve the potable water management system.

For communities to lead a healthy, productive and dignified lifestyle, access to adequate supply of potable water is indispensable (Haylamicheal and Moges, 2012; WHO, 2014). About 884 million people in the world still use open and unprotected potable water sources, such as springs, fountains, rivers, wells and ponds, which are prone to contamination, hence, are thriving sources of water;borne diseases (Haylamicheal and Moges, 2012; WHO, 2014). Evidently, water crises in rural communities often exacerbate the spread of water-borne diseases and loss of life (WHO, 2014). Over one billion people were reported to have been affected by water-borne diseases associated with inadequate potable water supply throughout the world in 2014 (WHO, 2015; Rodriques *et al.,* 2015). This is a concern that should be taken seriously and addressed.

Severely affected by water-associated challenges are predominantly women and children as in most rural communities, especially in developing countries, women and children walk long distances to access potable water (Naiga *et al.* (2015). Mukuhlani and Nyamupingidza (2014) observed that women and children spend hours queuing for potable water at the expense of their education and other household responsibilities. This defeats the SDG agenda for equitable access to water. The issue of water crisis continue to linger, since, it is only with 29% of the world's population, that water supply systems are funded, implemented and regularly reviewed (WHO, 2014). In many countries, lack of management, lack of proper monitoring of water sources and water supply system contribute, significantly, to water crisis (WHO, 2014). Arguably, rural areas are confronted by most of these challenges, hence, the need for policy reforms informed by grassroots concerns, to leverage solutions to the water supply problem.

In Latin America, people who lacked access to potable water were estimated to be more than 36, 8 million (Akhmouch, 2012; De Souza and Da Silva, 2014). The report further indicated that poor maintenance of water supply infrastructure was still a challenge in rural communities, therefore, issues like, substantial water wasteage, was caused by aging infrastructure, lack of operation skills, and poor maintenance of the water supply systems. Southern Asia and Sub-Saharan Africa struggle with the supply of safe drinking water as significant proportions of their rural population still use unprotected water sources from fountains and rivers.

There have been concerted efforts made by countries such as, Ethiopia, Benin, Lesotho, Malawi, and the Gambia to improve potable water availability, however, there are still many rural communities in Africa without water services (Itoua, 2012). There are efforts to remedy the situation, for example, the African Development Bank (ADB) has invested about 5 billion United State of America Dollar (USD) in potable water-related projects in Mozambique (EL Azizi, 2015). A similar project was also implemented in Bangladesh - "Community Approach to Total Sanitation (CATS)" (EL Azizi, 2015) - with the aim of addressing water problems. These show real commitment to improving potable water supply in Africa by the African Development Bank.

In Congo, about 31% of the population and about 35% of Nigerians still use unprotected water sources (WHO, 2013). This is an indication that, unfortunately, these potable water supply intervention strategies seem to be ineffective in mitigating the water challenges among communities in the rural areas. There is a need, thus, for improved intervention strategies which are also cost effective, to mitigate the problem.

Before 1994, the South African government policy on separation of people according to race stated that services, including water, should not be distributed equally to all South Africans (The Group Areas Act 41 of 1950). The supply of potable water was racially biased, favouring the white minorities and excluding the black majority who were mostly in rural areas (Schreiner, 2006; Gool, 2013). The provision of potable water in South Africa, hence, was controlled by race and class, whereby, the black majority could not get potable water due to separate development policies used during the apartheid form of governance (Schreiner, 2006).

The Group Areas Act 41, (1950), institutionalized segregation of people in terms of their races. One result of this was that, the potable water supply infrastructure and welfare services were poorly developed in black townships and homelands (Schreiner, 2006). The democratic government in South Africa has been in power for more than 25 years now, however, the imbalances of potable water distribution created by the apartheid government are yet to be adequately addressed, albeit, there have been some improvements since 1994.

The South African government put in place various policies to address potable water supply system in rural communities in South Africa, to address the legacy of apartheid. The Free Basic Services Policy (2000), guarantees that each household is entitled to an essential supply of 25 liters of water per person, per day; despite this guarantee, the country still faces difficulties in implementing the policy, in most rural municipalities. One of the reasons for the government being unable to provide consistent water supply is due to service backlogs, according to Mema and Mothetha (2013). The prevalence of water service delivery demonstrations is a clear indication that the progress made in making potable water accessible to rural communities is still inadequate (Managa, 2012).

The South African Constitution, Schedule 4B of Act, 108, (1996) mandates the national, provincial, and district municipality governments to work together to ensure the provision of potable water to the population. Most rural district municipalities, however, face numerous challenges in providing potable water to the communities (Mema and Mothetha, 2013). The VDM, the study area, is one of the water service authorities in South Africa in line with the Water Service Act 108, (1997); unfortunately it has been faced with numerous challenges. These include amongst others: aged potable water infrastructures inherited from the previous apartheid government and the former homeland states, financial and human capacity constraints, and the geographical location of the District in a rural area (Vhembe District Municipality, 2009). As mentioned earlier, the United Nations (UN) (2014) notes that the intervention for potable water

supply systems in rural communities requires countries to have a strong capacity to implement plans and monitor them. The Pan American Health Organisation (PAHO) (2011) reiterates that weak water management strategies, result in inadequate or lack of potable water supply by governments.

Potable water supply remains elusive, particularly in rural areas, although, there are legislative measures and processes which have been put in place. In the VDM, rural communities continue to experience frustrations due to unreliable and poor potable water service provision by municipalities. Mothetha, Nkuna, and Mema (2013) observed that there were communities that still lacked access to potable water within the Municipality. Such communities then resort to using unprotected water for domestic purposes. The potable water supply challenges in rural communities can be resolved, if effective intervention strategies for potable water supply systems were put in place, a view echoed by Kharraz *et al.* (2012).

The study addressed the following research questions, namely, *What are the existing potable water supply sources in VDM? How effective is the current potable water supply system in VDM in meeting the rural communities' potable water supply needs? What are the challenges and coping strategies used when there are potable water supply problems in VDM?* Lastly, the study developed intervention strategies and recommendations to improve the potable water supply system in the VDM for rural communities.

1.2 Statement of the Research Problem

About 62% of South Africa's rural households have interruptions in their potable water supply (Statistics South Africa (STATSSA), 2013). The Vhembe District Municipality (VDM) is the constitutional water supply authority in a District which has significant water reservoirs, namely, Nandoni, Vondo, and Albasin dams, however, its rural residents continue to experience consistent disruptions in their potable water supply. The cholera outbreak in Hamakuya, all former homelands in Bushbuckridge and Chris Hani District Municipality in 2013, is indicative of the challenges facing the District's potable water supply services (Cothren, 2013). There are also claims that the District lacks institutional capacity to address its chronic water supply system failures (Mema and Mothetha, 2013; and Johannessen *et al.,* 2014).

The intensity of protests and frustrations among the residents due to lack of water-service related issues in Vhembe District seem to confirm this as noted by Managa (2012). Choi *et al.* (2017) assert that part of the problem can be solved if rural communities share the cost for water supply

services to maintain sustenance of the service. A study by Bayene and Luwesi (2018) also confirmed that weak community participation and involvement in the water supply management are the main reasons financing for sustainable development is constrained. Studies by Omarova *et al.* (2019), Hutton (2016) and Bazaanah (2019) identifed decentralisation and participation in water service delivery by communites as attributing to successful rural water projects' implementation. It was, thus, on this basis that this study was conducted, to develop an intervention strategy that may be adopted to improve and sustain a potable water supply system, for the rural communities in the District.

1.3 Justification of the Study

The study addressed potable water supply challenges faced by the rural communities in the VDM by developing a more effective intervention strategy for improving potable water supply. The study's results, hence, could contribute to improved supply of clean water for drinking and domestic use. Findings, will also provide research-based information that should help the municipal councilors, administrators, and policy-makers in the government to improve on their policies on the provision of potable water to rural communities. It is anticipated that if the interventions outlined in this study are adopted and implemented, the breaking down of the systems, non-maintenance of the infrastructure, opportunistic waterborne diseases, and the current frequent poor water-service delivery protests, in the district, might be drastically reduced.

The study further would contribute towards the advancement of vision 2030 of the National Development Plan (NDP) which states that all South Africans will have access to clean running water in their homes by 2030. The results will also contribute to the current Sustainable Development Goals of 2030 realisation, which requires availability and sustainable management of potable water and sanitation for all. Finally, the study will contribute to the body of knowledge about supplying of potable water and any intervention strategies that would ensure that rural communities have access to uninterrupted supply of clean water for drinking and domestic use.

1.4 Objectives of the Study

The main objective addressed in this study was to propose an appropriate intervention strategy for an effective potable water supply system to rural communities of the VDM. In order to address the main objective, the following specific objectives and questions were addressed. They were, to:

a) Determine the current potable water supply sources in rural communities of the VDM;
b) Examine the effectiveness of the current rural water supply system in meeting the potable water supply needs of rural communities in the VDM;
c) Identify the challenges and coping strategies used to meet potable water supply in the VDM; and
d) Propose appropriate intervention strategies for effective potable water supply to rural communities in the VDM.

1.5 Research Questions

a) What are the current potable rural water supply sources in the VDM?
b) How effective are the current potable water supply systems in meeting the water needs of rural communities of VDM?
c) What are the challenges and coping strategies used when supplying water to rural communities in VDM?
d) What are appropriate, effective intervention strategies to improve the potable water supply systems in rural communities of the VDM?

1.6 Conceptual and Theoretical Framework of the Study

This section outlines the conceptual and theoretical framework of the study.

1.6.1 Conceptual Framework the study

The District Integrated Development Plans (IDP), Budget, and other legislative frameworks indicate that the VDM should supply potable water to its rural communities. A system perspective approach on the supply of water to rural areas of VDM was the bases for the conceptual framwork. In this approach, rural communities, councilors, municipal officials, and traditional leaders are regarded as stakeholders with solutions to problems at hand; it is then assumed that if their interactions and collaboration are embarked on solutions to problems can be found, and in this case, water problems in the VDM. The challenges experienced in the VDM were lack of and inconsistent water supply, which necessitated intervention strategies to be devised to improve the situation.

Figure 1.1 presents the conceptual framework developed in line with the current national policies as reflected in the Water Service Act (108 of 1997), Water Act (36 of 1998), Local Government Municipal Acts, and Vhembe IDP. The study regarded the management of rural potable water supply as made up of a collective of stakeholders: rural communities, households, national, provincial and local governments, Non-Governmental Organizations, traditional leaders, councillors and administrators (Cothren, 2013). These various stakeholders, therefore, have a role to play in the active intervention strategies developed by this study. Given the above scenario, input from households and traditional leaders (demand side), municipal officials and councilors (supplier side) potable water supply can be improved in the District. Their views, therefore, were critical for the study to develop intervention strategies which may be adopted by the VDM to address water challenges in the area. This approach is appropriate, since water service authorities, like the VDM, are accountable to the community for efficient and effective delivery of essential services, including potable water to the rural communities.

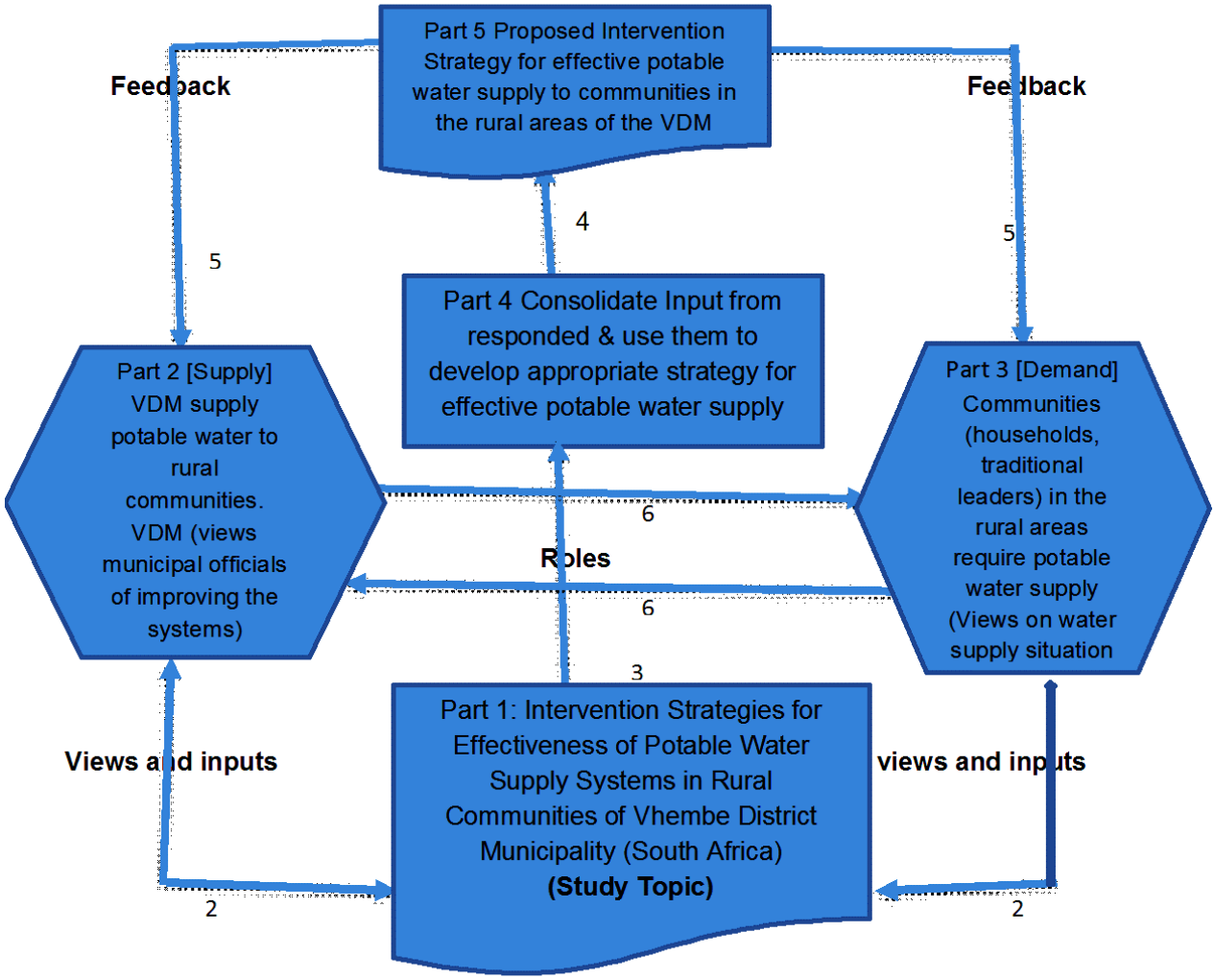


Figure 1.1 Conceptual Framework of the study (Researcher, 2019)

The first part of the framework was informed by challenges experienced by households in (Figure 1.1). Part two is where the VDM is situated, as the supplier of water services according to its mandate derived from the Constitution of South Africa (Act, 108 of 1996), hence, views of municipal officials and local municipality councilors are critical in addressing the study problems. Part three indicates communities' demands on the availability of water; information for this part was gathered from stakeholders, such as households and traditional leaders from different local municipalities, so that relevant intervention strategies could be developed.

From Figure 1.1, VDM is the supplier of water services, and households, including traditional leaders, are recipients of the water service. The other pertinent point was whether each

stakeholder from the VDM and households played their part in water supply sustainability. Part four is the consolidation of input from households, councilors, municipal officials, and traditional leaders. Part five is the proposed intervention designed from input from stakeholders through the study's investigation. After the development of the framework, feedback on this proposed intervention will be given to households, VDM officials, including councilors and the municipality, who will then decide whether they will adopt the intervention in a bid to address the potable water supply challenges in the District.

1.6.2. Theoretical Framework of the study

This study was anchored on the Systems Approach Theory adopted from (input-output) by Du Plooy- Cilliers *et al*. (2014), as presented in Figure 1.2. The Theory consists of essential elements and processes described as - input, output, transformation process, feedback, and environment. In this study, the System Approach Theory entails the following: 1) When communities have an issue to be resolved, they lodge their grievience to the Municipality, or issue a demand; 2) the Municipality processes the demand and a solution is found and reported back to the community; 3) when the communities are not satisfied the same process unfolds again until an amicable solution is found. The same process, thus, is followed when the communities have water supply service issues.

In Figure 1.2, Inputs refer to information from the external environment comprising of communities, households and other stakeholders who are involved in water issues, such as, the demand for potable water supply. In this study, the inputs were generated and consolidated from households, councilors, and municipal officials. Data was gathered from stakeholders - households in the communities, traditional council leaders, municipal councilors, and municipal administration officials. The stakeholders provided valuable data about the state of water supply, its effectiveness, challenges, and how they are coping with water challenges at the municipal and household levels. All inputs were consolidated. **The transformation process** refers to the consolidated inputs from the data collection process. The inputs were then processed to enable the development of appropriate strategies for an adequate supply of improved potable water supply to rural communities and, in the end, if adopted, may be included in the Municipality strategic plan (IDP).

Output refers to results achieved after all inputs were processed. This study's output was the intervention strategies generated for effective potable water supply systems to rural

communities. **The Feed-back** refers to organized sessions that present the results of the study or solutions to all stakeholders who participated. The results if accepted are then piloted. When the feedback or results of a pilot study do not satisfy or resolve the problem, the results will be reviewed, re-energized and improved in the hope of achieving the desired results. Participants would be allowed to interrogate the results to confirm whether they represented their views. Proposed intervention strategies would also be presented to the stakeholders for engagement and adoption. The systems approach is diagrammatically presented in Figure 1.2.

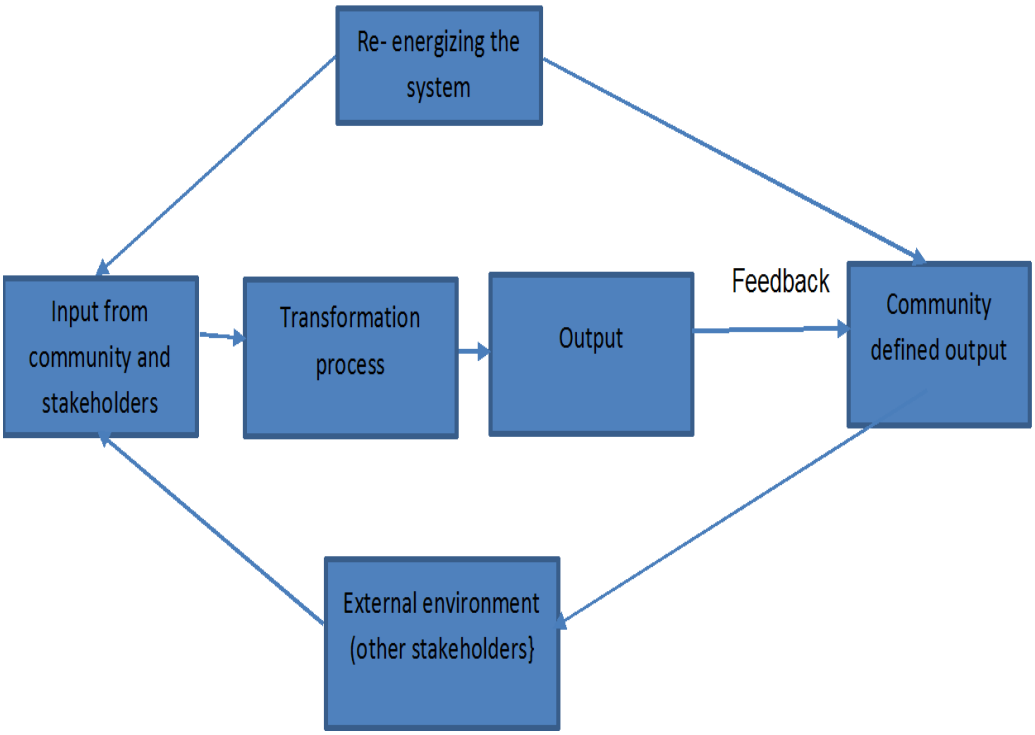


Figure 1.2: The Systems Approach Theory by Du Plooy – Ciliers *et al.* (2014)

1.7 Operational Definitions of Key terms and Concepts

Potable water is water suitable for human consumption and domestic purposes; it must be including hygienic, hence, free from contamination (Burack *et al*., 2015). *Adequate potable water supply* – is in line with the legislative mandate provided in the South African Constitution, Act 108 of 1996; the term will be used in this study to refer to the sustainable and cost-effective supply of potable water, regularly, to rural communities in VDM.

According to the VDM (2010), *a potable water supply system* is a systematic way of regularly supplying potable water to the rural communities, by a water service authority, like the Vhembe District Municipality. This study adopts the definition of a *District Municipality* as defined by the Local Government Municipal Demarcation Act (Act 27 of 1998) and Municipal Structures Act (117 of 1998) "as an organ of state within the local sphere of government, exercising legislative and executive authority within its area of jurisdiction," consisting of political structures, administration and the community in the Municipality.

District Municipality is a Category C municipality which has executive authority, comprising of a mayoral committee or executive management team (mayor, speaker, and chief whip) and administrative components (municipal manager and section 57 managers) as per Section 155(1) (c) of the Constitution of the Republic of South Africa Act, (106 of 1996) and Section 10 (a) of Municipal Structures Act, (117 of 1998).

In this study, *rural communities* are households or people who reside within the villages and make use of services or facilities provided by the municipality and are involved in local affairs of the municipality, as defined by Municipal Structures Act (117 of 1998) and Municipal Systems Act (32 of 2000).

Effectiveness of the water supply in the context of this study will indicate the ability of the VDM to comply with constitutional requirements for water supply service; that is the ability to give enough quantities of water, of about 25 litres, per person per day within 200 metres from the yard. The effectiveness should be such that no consumer is without supply for more than 7 full days in a year (Water Service Act, (108 of 1997).

1.8 Outline of the Thesis

Chapter 1 outlines the study's background and issues relating to clean water supply for drinking and domestic use by the rural communities in the VDM, including the primary sources where the water is obtained. The statement of the research, justification for the proposed study, the objectives, and the research questions are stated in this chapter.

Chapter 2 reviews the existing literature about potable water supply systems in rural areas. The literature review highlights the current state of potable water supply, the effectiveness of water

supply systems, challenges and the coping strategies to deal with the water supply crises in the VDM.

Chapter 3 explains the research methodology used in the study. The research design is also outlined as well as the population, sampling procedures, data collection instruments. The data analysis process and techniques are also explained to show how they address the study problem. Also explained are how issues of ethical compliance were observed throughout all stages of the study.

Chapter 4 focuses on the results' presentation, discussion, as well as providing an analysis of the existing water supply sources in the VDM.

Chapter 5 provides an analysis of the ability of the current water supply system in meeting the potable water supply needs of rural communities of the VDM.

Chapter 6 highlights the challenges in providing potable water and the coping strategies used in the VDM to address these challenges.

Chapter 7 summarises the main findings, conclusions, and recommended intervention strategies to improve water supply systems in VDM.

All literature used to develop this study is acknowledged in the reference section and an appendices' section is also included.

CHAPTER 2: REVIEW OF THE LITERATURE

2.1. Introduction

In this chapter, relevant literature was reviewed. Literature focusing on the state of potable water supply, globally, regionally, and locally in rural communities was presented. Details were also provided on potable water supply systems, challenges faced by rural communities, coping mechanisms and rural residents' level of satisfaction with their potable water supply. Lastly, a comprehensive summary of the literature is outlined.

2.2 Global perspectives on potable water supply

Various studies (Basson, 2012; UNICEF and WHO, 2012; EL Azizi, 2015) have shown that the provision of potable water (a source of life), was in crisis mode. People depend on potable water to maintain basic hygiene; as a result, lapse or failure to deliver such service often resulted in disastrous health impact and social consequences (UNICEF and WHO, 2012; Marshall, 2013). It is observed that water supply to rural communities and its management are global problems that require urgent intervention, as water is life. It was against this background that a study of this nature was undertaken to ensure consistent and sustainable water supply.

Globally, water supply literature, shows challenges with providing potable water to rural areas (UNICEF and WHO, 2012). The report further indicates that under 2 billion people in rural areas were without access to potable water (UNICEF and WHO, 2012). WHO (2013) and the United Nations Joint Monitoring Programme state that 783 million people worldwide, predominately in the rural areas, continue to use unimproved water sources. Kalt *et al.,* (2014) concur that rural communities continued to depend on unimproved water sources, such as streams, fountains, rivers, and springs for their water. Many rural communities still use such open water supply sources which are contaminated with water-related diseases. There is a need, therefore, to provide protected water sources to rural communities, if we are to address this problem. This study, thus, is about intervention strategies that could help address the concerns on potable water supply and its access to rural communities. A study by Ravet and Brailowski (2014) on Haiti, revealed that potable water supply was inadequate because Haiti was the poorest country in Latin America and the Caribbean. It is further indicated that the potable water supply level was low due to lack of - financial, human and institutional - know-how on water supply systems Communities in Haiti have a partnership with a French company to deliver potable water to communities through

private trucks. The company also delivers potable water through retail shops and private tanks (Ravet and Brailowski, 2014).

About 60% of Chinese water supply systems depend on shallow wells operated by hand or electric pumps and these supply water to whole villages; about 9% of the water come from streams, and 3% come from rain-water harvesting. According to Doria (2006) about 27% of rural communities in Florida relied on private water supply systems with more than 60% of rural communities relying on piped-water supply from boreholes.

Marshall (2013) argued that the challenge of rural water supply was due to poor management of potable water supply sources, population growth, and droughts. Some of these concerns can be addressed when rural communities are engaged and capacitated in the process. WHO (2014) confirmed that inadequate monitoring, weak capacities of countries to implement plans, insufficient funding for infrastructure, and lack of capacity of officials as some of the root causes of potable water challenges in rural communities and in many countries. Some gaps which hinder sufficient water supply, as identified from the literature reviewed, are poor management of the systems, mismanagement of sources, the incapacity of governments and municipalities in the implementation of plans due to lack of expertise and funding of water projects.

The above literature dealt with rural water supply issues from a generalized global perspective, hence, in the process, specific issues that pertain to particular countries, such as South Africa, were neglected. South Africa has water supply inadequacies that are unique to rural areas, the Vhembe District Municipality being a case in point here. The neglect, therefore, has created a gap in the literature that requires urgent attention. It is within this context that this study was done to help fill the gap in knowledge concerning the VDM potable water supply system to its rural areas.

These studies, however, were relevant to this one as they provided varied views regarding the portable water supply systems in various regions throughout the world. This study used their inputs to critically assess the VDM potable water supply systems, from a global context. These studies were used to analyse data collected from this District and formed the basis for a comparative analysis of issues raised during the data collection process for this study. From the literature reviewed, funding hinders sufficient water supply as it results in poor management of the systems, at village and ward levels through to the Municipality level. Within this context, the study came up with an intervention strategy for effective potable water supply systems in rural areas of VDM. Most African countries rely on streams, fountains and hand-dug wells, together with rainfall harvesting, natural springs and shallow wells as sources of potable water; naturally,

the majority of these water systems are highly unreliable during the dry seasons, hence, the need to find alternatives which invariably requires funding (Adeoye *et al.,* 2013).

2.3 Potable water supply among rural communities in the sub-Saharan Africa

Regionally, about 65% of households in sub-Sahara Africa have inadequate potable water supply service, which is hampered by inadequate and lack of infrastructure (Economic Commission of Africa: (ECA), 2012; Obeta and Nkwankwo, 2015). Efforts have been made to improve potable water supply, especially in Africa's rural areas, however, the progress made has not been encouraging (Marshall, 2013). Access to the potable water supply, therefore, is still a challenge in Africa, and efforts need to be doubled, to seek solutions.

Adeoye *et al.* (2013) found that more than 90% of sub-Sahara Africa still depend on contaminated streams, fountains, rivers, and shallow wells for their potable water access and survival. Mukuhlani and Nyamupingidza (2014) discovered that about 25% of people in the whole of Africa experience water pressure due to the unprotected nature of the sources. The use of such unprotected water is mainly due to there being no infrastructure to deliver potable water to rural communities and the unprotected sources are highly unreliable during the dry season. The study further indicated that potable water shortages in sub – Sahara Africa can be attributed to global warming, drought, and population increase (Adeoye *et al.,* 2013). The majority of the African population, therefore, still depend on unprotected water sources to satisfy their daily needs.

Projects, such as the One Million People Project in Mozambique, and other water-related projects in African countries, like Benin, Malawi, Lesotho, and Mali (UNICEF and WHO, 2012) have been initiated to address potable water shortages. Some rural communities seek donor funding to deliver water to their households due to inadequate funding. As a country in sub-Sahara Africa, South Africa equally shares the problems highlighted by these studies, however, their generalized approach does not address, specifically, the issues in the VDM of South Africa's Limpopo Province.

These studies generalized approach gave rise to the need to conduct a specific study on the VDM's potable water supply concern, an initiative this study took up; the results would fill the literature gap that these studies had created. Their significance is realized in their provision of a generalized background information on diversified portable rural water supply problems as they affect various countries in sub-Sahara Africa.

This study's facts and arguments arose from the data collected. In short, various studies were used to situate this one in the context of what other scholars have already written about the phenomenon being studied here. The study proposes intervention strategies for potable water supply for the benefit of rural communities.

2.4 The status of South Africa water supply to rural communities

According to Hogg and Samson (2011) the legacy of apartheid in South Africa presented the new democratic government with poverty, inequality, and immerse potable water backlogs. The government enshrined constitutional rights to service access, policies, and funded potable water delivery programs in many rural communities which did not have water access. The Presidential Proclamation in 1994 paved the way for the establishment of various departments in support of new ministerial portfolios. These portfolios include, amongst others, the Department of Water and Sanitation (DWS), which is responsible for water governance, management, and supply, however, municipalities are still confronted with service delivery challenges from reasons, such as lack of skilled technicians and financial resources to address potable water supply.

The number of service protests throughout the country, including in the VDM, indicates that there are still challenges to potable water supply (Monashane, 2011). Service delivery challenges that exist within South African municipalities, including VDM, are rooted in their failure to implement Integrated Development Plans (IDP) and socio-economic programs in local governments (Monashane, 2011). This challenge frustrates the receivers of water services, mainly those who are in the rural communities, resulting in violent protests.

Potable water service provision, in all three spheres of government has undergone several phases, and changes since 1994, characterized by too many policies, incoherent and short-lived action or campaigns, lack of proper coordination, inadequate implementation plans and lack of political which leads to non-participation by communities (Monashane, 2011; Basson, 2012). The long list of policies on the water supply developed by the South African government seems to be *ad hoc* mechanisms which arise in response to emergencies and community pressures in the form of protest and strikes (Managa, 2012). These are discussed below.

The following Acts were enacted to assist in delivering potable water services to communities, including rural areas. The Constitution (Act 108 of 1996) guarantees fundamental human rights and potable water access to every citizen as essential service (Chapter 2 of Bill of Rights and Section 27 of the Constitution of South Africa Act 108 0f 1996). Through the Municipal Structure

Act (117 of 1998), the municipality exercises its executive and legislative powers to provide potable water and other services. Municipal System Act (32 of 2000) provides for the community and public participation through formal representatives and active participation of residents in matters that affect them, like potable water. The Water Service Act (108 of 1997) provides for regulatory framework relating to water usage, provision, and management while the Water Act (36 of 1998) provides for the protection and conservation of national water resources.

The White Paper on Transforming Public Service Delivery (1997) provides a consolidated relationship between the community and the municipality. These legislations and policies emphasize the transformation of the municipality and provision of service delivery, which includes potable water supply so that it becomes safe, affordable, and sustainable. The sustainability of rural municipalities depends on the overall legislative framework on rural infrastructure and the development of rural areas, however, the indications are that delivery of potable water by VDM is still a challenge, despite the legislative mandate and framework.

The Municipal System Act, Section 16 (1), (Act 32 of 2000) advocates for 'a people-centred approach' to service delivery where each municipality develops a governance culture that complements a formal representative government system which encourages community participation in actions that concern them, among others, water supply systems' management (Cothren, 2013). The South African Republic, has, therefore, not been immune to challenges of rural water supply to communities, which had been exacerbated by the past historical evils of the apartheid system of governance.

Legislation and policies are available, however, there are still challenges to ensure that the policies are implemented and communities are provided with potable water supply. To some people, adequate water supply remains a pipe dream. The Vhembe District Municipality was established in 2000 from the Local Government (Municipal Structures Act 117 of 1998). As one of the water service authorities in South Africa, the District is confronted with water-related challenges that include, amongst others, aged water infrastructures inherited from the former homeland states (Cothren, 2013), financial and human capacity constraints as well as a rural geographical location (Vhembe District Municipality, 2009).

The District's water supply is characterized by poor access, limited achievement, and several challenges. A typical potable water supply challenges faced by rural communities is a dramatic decrease in their Green Drop Status Assessment of Water Quality in the VDM in 2011 (Basson,

2012). Vhembe District Municipality and Mookgophong scored the lowest, at 26% and 39%, respectively, in the Green Drop scorecard. The quality of water was said to be polluted due to poorly maintained water treatment plants and sewage lagoons, making it dangerous for people to drink (Basson, 2012). This analysis meant that the quality of rural water supply in the area did not meet the required basic standard for human consumption (Monashane, 2011; Basson, 2012; Brettenny and Sharp, 2016).

From a countrywide perspective on portable rural water supply issues, these studies also failed to articulate the VDM's potable water supply problems. Most of these studies dealt with issues related to the quality of water provided or used in rural settings. For example, Basson (2012) discusses the phenomenon from a comparative perspective, thereby missing the fundamentals issues concerning the VDM. This neglect then necessitated this study, which used previous ones as the ladder from which to confront the VDM's potable water supply issues and how they affect rural dwellers. Previous studies above looked at issues such as community protests informed by poor delivery of various services by different municipalities.

This study does not directly address the VDM's rural water issues *per se* but focused on a collective view of how communities react when municipalities' service delivery systems are weak. This approach provided the necessary argument for undertaking this study as it focused on portable water issues that directly affect the VDM. The above studies indirectly called for studies of this nature by leaving gaps in literature, particularly on rural communities such as VDMs.

In South Africa, the literature reviewed showed that although legislation is in place to enforce water provision in rural households, there is a need for intervention in implementation and review of some legislation to encourage active community involvement in the water supply systems. There is a visible gap between policy and implementation, which hinders the provision of water in rural communities, especially, in the VDM.

2.5 Potable water supply systems in rural communities

Rural communities rely mainly on underground water, streams, fountains, wells, and hand-held pumps. According to Godfrey (2011) and Campos (2014), the water supply systems situation in China is decentralized to rural communities, similar to the procedure in Florida (Doria, 2006), Haiti (Ravet and Brailowski, 2014), and Nigeria, in the Kwara District (Adeoye *et al.,* 2013).

In most African countries, water supply infrastructures are absent, for example, in Nigeria, the majority of rural communities do not have an established potable water supply system, and where

such systems do exist, they are either not functional or completely broken down (Adeoye *et al.,* 2013; (Obeta and Nkwankwo, 2015).).

Jagals (2012) states that water supply in South African rural areas are through boreholes, rivers, springs, and drilled wells, although, in some areas, water is supplied through elevated water-holding tanks distributed to communities. Motorized pump, diesel pump, and hand pumps are mainly used to draw water from boreholes in South Africa (Jagals, 2012). In addition, public standpipes are also a popular system used in many South African rural communities. The literature reviewed concluded that the state of potable water supply systems in rural areas need acute interventions. Some countries which are effective in providing water access are able to do this due to them having many source options to address water supply concerns; this is useful as a baseline and comparative analysis of water supply for this study.

2.6 Factors affecting potable water supply to rural communities

Johannessen *et al.* (2014) viewed poorly-designed and aging infrastructures as the main problems, causing potable water supply systems' ineffectiveness in rural areas. Johannessen *et al.* (2014) continue that broken infrastructure which disruptes potable water supply systems in rural areas, take long to fix; during this period, communities have no option but to collect potable water from unprotected sources.

The quality and quantity of water supplied in Africa is generally inadequate due to poor technology and high costs, which are challenging to manage (Rivas *et al.,* 2014). Communities establishing unplanned settlements is another cause of lack and inadequate water supply. In these settlements, there is no infrastructure due to lack of financial and technical resources as there is no budget allocated to cater for water supply systems that were not planned. According to Tadesse *et al.* (2013), rural communities should play a role in the operation and maintenance of potable water infrastructure in their areas. Cobbing (2014), Naiga *et al.* (2015) assert that potable water supply pumps' failure are mainly due to wear and tear, theft and vandalism; these pose severe challenges to potable water supply in rural areas.

Ineffective operation of equipment and poor maintenance of infrastructure in most water institutions are due to lack of skilled technicians and operators as well as maintenance specialists in rural areas. According to Obeta and Nkwankwo (2015), in Africa, many hand pumps are not operational, due to lack of affordability or acceptability by communities, inadequate supply of equipment and spare parts for their operation and maintenance.

Mema and Mothetha (2013) reiterate that inadequate maintenance and operations of borehole pumps, reservoirs, pipes, and street pipes cause water supply challenges which are aggravated by leakages due to damaged pipes . Groundwater supply failure, thus, is linked to lack of and inadequate operation and maintenance of water sources (Cobbing, 2014).

Cobbing (2014) maintains that most municipalities do not have a budget for operations and maintenance of water supply systems, which hampers water distribution to rural communities. Manuel *et al.* (2015) supported this view by indicating that without funding, operation, infrastructure maintenance and upgrading water sources cannot be sufficiently managed. A study by Manuel *et al.* (2015) outlined that 70% of infrastructure collapse due to non-maintenance, vandalism and budget constraints. Obeta and Nkwankwo (2015) concur that municipalities in rural areas struggle to secure funding and generate revenue, as there are limited industries and investors; the situation is worsened by most households being unable to pay for water usage.

Kharraz *et al.* (2012) pointed out that the lack of access to potable water was a leading cause of death worldwide, and this was through dehydration, diarrhoeal diseases caused by drinking contaminated water. In Iraq, Pakistan, Afghanistan, and West Africa, water scarcity have led to drought and famine, which have compounded people's difficult livelihoods and the spread of waterborne diseases. According to WHO (2013), about 780 million people continue to use unimproved water supply facilities to satisfy their daily water needs. Kalt *et al.* (2014) add that untreated water exposes humans to contaminants, and about 1,5 million people die every year due to the consumption of untreated or contaminated water. According to this report, these deaths are preventable through access to safe drinking water in rural communities.

There is, hence, an urgent need to establish water management strategies and committees to address potable water supply in rural areas. Kharraz *et al.* (2012) continues that in Africa, for example, in Guinea, 4,900 people die every year due to water, sanitation, and hygiene-related illnesses. The Economic Commission of Africa (ECA) (2013) documents that about 62% of the rural African population have no access to adequate potable water supply. Africa is one of the regions where the majority of the population reside in rural areas. Hove and Tirimboi (2011) and Chaminuka and Nyatsanza (2013) in their studies show that the inability to provide potable water supply to Zimbabwean communities in 2009 led to 191,164 reported cases of cholera epidemic leading to 4,047 deaths being reported, between 2008 and 2009.

The availability of skilled staff is essential for potable water supply to rural communities (Cobbing, 2014), however, the 2011 municipal capacity assessment (Demarcation Board, 2012) reported a

general shortage of municipal engineers who can assist in the operation and maintenance of potable water supply systems in rural areas. The South African Human Rights Commission (2014), claims that many municipalities, particularly those who are poor and in rural areas, do not have skilled personnel in water services, with the capacity to implement their mandates. The concerns around skills' shortage have been supported by Managa (2012) who contends that the situation has resulted in service backlogs that hamper municipalities from supplying potable water services to rural communities, effectively. Water-related skills are vital in operating potable water supply systems, in rural communities.

WHO (2013) has commented on the lack of leadership and coordination between municipalities and stakeholders, making it difficult for potable water to be supplied to communities. According to Bliss and Fisher (2013), the lack of managerial capacity lead, for example, to funds budgeted for diarrhoea projects in rural areas, not being spent. Marshall (2013) and WHO (2014) concur that management and leadership are essential for the adequate performance of organizations, particularly, on water affairs. Management and leadership responsibilities serve to improve the performance and satisfaction of communities with regard to potable water supply. WHO (2014) stresses that inadequate management plans, non-planning on water use, and poor conservation contribute to potable water shortages in South Africa; where there is a lack of management and leadership, reduced maintenance and deteriorating infrastructure, and non-efficient operation of potable water shortages manifest itself (WHO, 2014).

There are a multitude of factors that impact negatively on the supply of potable water to rural communities in VDM. Recent waves of protest and spates of violence across South Africa by residents over potable water service delivery by municipalities, have received enormous media coverage and exposed the challenges which many municipalities face in terms of service delivery (Cothren, 2013). It seems that poor budgeting, finance shortages, poor water system management, non-attention to water sources, and lack of ownership of the system from water users are the main challenges in most countries failing to achieve effectiveness in their water supply.

This study sought to find an appropriate strategy that would reduce and eliminate water supply challenges in the District. Based on the reviewed literature, there are no clearly-defined intervention strategies in most countries. Budgetary constraints were cited as the main challenge in coming up with a defined strategy, hence the reason for carrying out this study.

2.7 Rural residents' views on provision of potable water supply systems

Community satisfaction is the extent of the fulfilment and gratification of needs for stated goods or services, for the community (Jayaramu, 2014). When institutions improve the quality of potable water supply services, communities become happy and satisfied, while poor water service and poor customer-care led to negative attitudes, for example, towards the payment of potable water services (Jayaramu, 2014). Lack of satisfaction leads to resistance to increased tariffs and the unwillingness to pay.

Noga and Wolbring (2015) revealed that the complaints received from some residents in Scotland indicated that communities are not satisfied with the potable water quality and supply systems. Sandeva *et al.* (2015) point out that 63% of the residents in Bulgaria complain about the unpleasant smells and hardness of water; they add that weak institutional capacity is the main obstacle to quality water provision. This causes dissatisfaction in communities, rather, regular updates on water services, reliability of supply, timely and accurate responses to inquiries, resolving complaints and good quality of water supply, all lead to high community satisfaction (Jayaramu, 2014).

Communities compare their satisfaction against past performances (Jayaramu (2014). The measures of satisfaction pose questions about past experiences and opinions in relation to current policies and practices of water services when measuring community satisfaction with potable water supply. Jayaramu (2014) asserted that if water managers know what customers want and expect, they can adapt their strategy to improve water service provision to concerned customers. It can be argued that when municipalities address water challenges as per customers' expectations, rural water access can be achieved from an informed point of view. According to Jayaramu (2014), some of the greatest concerns of water users are those that are related to the functioning of call centres, billing and product quality and the reliability of supply; these are issues that respondents find important and need to be satisfactorily addressed

Rural communities are often left out in decision-making that concerns water projects within their areas, even though they appear to be very willing to support various forms of water development (Lockwood and Smits, 2011). This is consistent with Kumpel (2013) and Daemane (2015), who reiterated that rural communities often indicated their willingness to pay in order to receive satisfactory potable water supply service. It can, therefore, be argued that without proper community involvement and participation, it will be difficult to address rural water supply issues.

According to Daemane (2015), in most rural communities, the payment of potable water services sustains the water supply systems, and creates a sense of ownership and satisfaction. As argued earlier, what determines rural communities' degree of satisfaction to water supply ranges from water sufficiency, reliability of water supply, trustworthiness of management committees, convenient water point location, water quality and water pressure (Bhandari and Grant, 2007). Madrigal *et al.* (2010) added that communities view water supply satisfaction based on the taste, colour and turbidity. Jayaramu (2014) added that the dissatisfaction of rural communities with potable water supply is, usually, due to poor customer care by institutions responsible for potable water services. It is important for the water service authority to know what rural communities perceive as satisfactory potable water supply, so that the provision can be made according to their requirements.

A survey conducted in South Africa showed that national satisfaction with potable water supply systems has been decreasing since 2005, even though access to water is on the increase (STATSSA: General Household Survey, 2015). Unlike many rural communities in other countries in the world, it is not very clear what specifically might be causing the dissatisfaction in South Africa. The survey further showed that there is approximately 14.4% decline in the household water quality in the country. The level of satisfaction to water quality which stood at 76.4% in 2005 decreased to 62%, with suspicions of further decline. This comment is consistent with Rananga and Gumbo (2015) who discovered that only approximately 10% of rural communities sampled in a study conducted in Mutale Local Municipality of the country, were satisfied with current potable water supply in the country while 89% were dissatisfied.

Brettenny and Sharp (2016) reveal that an estimated 45.8% of South African households had access to piped water in their dwellings in 2015; a further 27% accessed water on-site; 13.9% relied on communal taps, and 2.7% relied on neighbors' taps. Households' access to water was improving, although, 4.4% of households still had to fetch water from rivers, boreholes, streams, fountains, stagnant water pools and dams, wells, and springs in 2015.

As a satisfaction measure, South Africa introduced the Blue Drop concept to assess water quality, quantity, and water supply systems' effectiveness. From the literature, the views of rural communities in terms of satisfaction was critical in addressing effective water supply, hence this study is essential in addressing potable water supply systems by the VDM to rural communities by coming up with strategies to satisfy communities' expectations and preferences.

2.8 The community's survival strategies with potable water supply challenges

Due to failure of public water supply systems and water demand that exceeded water supply, Jagals (2012); Akali *et al.* (2015); Mukuhlani and Nyamupingidza (2014); Lorlumun *et al.* (2015); Ahmed *et al.* (2015) and Cook (2016) identified some coping strategies that rural communities used to survive water challenges. These are - collecting water from rivers and streams, rain-water harvesting, hand-dug wells, drilling own boreholes, conserving available water and buying water from private providers.

Tshikolomo *et al.* (2012) discovered that rural communities survived by using less-safe sources of water, from wells and fountains. Other communities used water vendors or kiosks while wealthier residents had piped water from connections from their boreholes to cope with water shortages. Dhakal (2013) explains that some communities survived through fit-for-purpose water systems, where potable water can either be replaced by or increased through rain water, storm water and recycled water for domestic use. Rural communities in America, according to Doria (2006), relied on private water supply and private wells for their survival. Some rural communities used bottled water for drinking purposes.

Adeoye *et al.* (2013) noted that more than 90% of the households in Kwara's rural communities rely on contaminated streams, fountains, rivers as well as unclean and unprotected shallow wells for their potable water needs. This is due to the unavailability of water infrastructure. This is in line with Jagals (2012) who had indicated that rural water supply are drawn from rivers, springs and drill-wells, from several kilometres, thus, households spend several hours collecting potable water for domestic use. Lorlumun *et al*. (2015) confirmed also that communities walk long distances to fetch potable water due to the failure of public water supply systems. Health-related issues associated with consumption of contaminated water are also problems these rural communities face. In addition, there are economic costs in travelling distances to secure portable water. This bring us to the question: What role is the government playing to mitigate water-related challenges in these rural areas?

Rananga and Gumbo (2015) recommend that a pre-paid metered water supply systems, can be established for all to pay for potable water in water-crises areas to ensure portable water supply, although, it can be argued that pre-paid meter systems are expensive to be implemented. Furthermore, this system may further marginalise the poor rural households which may not be able to afford the cost of portable water. Cognisant of this challenge, Mukuhlani and Nyamupingidza (2014), Lorlumun *et al.* (2015), Ahmed *et al.* (2015) and Cook (2016) have

suggested alternative measures for leveraging water-related crises in rural areas. Among a myriad of, alternatives, water shedding across affected communities, drilling and rehabilitation of boreholes, water tanks, building water reservoirs and conserving natural water resources are most ideal. Arguably, at least one of these methods can be applied in every community, regardless of the distance, rurality or composition.

This study is necessary because previous studies did not say much about portable water supply strategies being implemented by the VDM in the first place. They are silent on what the VDM does in order to provide potable water to its communities. These studies mainly focus on other areas with different terrain and weather conditions to those of the VDM. This observation then called for the undertaking of this study to reveal how the VDM provides potable water to its communities. This study specifically dealt with how VDM strategizes in order to meet its rural communities' water supply needs drawing from the context of other areas in the country.

2.9 The success of current potable water supply systems in rural communities

Bagnoli and Megali (2011) define effectiveness as the ability to achieve goals and implement strategies while using resources, in a socially responsible manner. According to the Multi Constituency Model, effectiveness measurements took into consideration stakeholders' expectations. Sawhill and Williamson (2001) suggest that effectiveness can be measured by analyzing the impact, activity, and capacity, where *impact* measures mission success and in this case, potable water supply systems; *activity* measures achieving goals and implementation of strategies and *capacity* which measures the ability to mobilize resources to meet organizational goals and mission.

Effectiveness of potable water supply is measured on supply consistency based on measures outlined by Department of Water Affairs (2013), which mandates that interruptions of water supply should be less than 48 hours at any given time and cumulative interruption times of the year should be fewer than 15 days. Rietveld *et al.,* (2009) suggest that measures of effectiveness should consider the identified performance indicators on satisfaction with water availability. For this study, *water supply availability* refers to the quality and quantity of water in terms of the necessary level of supply outlined by Water Affairs (2013).

The second performance measure is the capacity of the system to store, transport, and distribute water to rural communities, which were measures in place for system sustainability. The third was continuity and consistency of potable water supply systems, and according to Department of

Water Affairs (2013), interruptions of water supply should be less than 48 hours at any given time and less than 15 days in a year, cumulatively. The fourth was the distance travelled by the members of the household, from their yard to the source.

2.10 Potable water supply strategies in rural communities

Community management strategy is used to supply rural communities with potable water (Lockwood and Smits, 2011; Tremolet, 2013). Users are established at the community level through the water committees to manage - potable water services, operations, and maintenance, house connections, and fee payments. Community management with local government structure has been legislated and professionalized, in some countries, like in India (Indian Ministry, 2011). The strategy was introduced for the Indians to address water shortages. The process includes households having metered connections with user charges. One of the weakness of this model is that communities have limited capacity to manage technical complex equipment for potable water and monitoring regular payments by users. This model is practiced in places like, Latin America, India, Ethiopia, Colombia, and some countries in Africa. The success of this model is based on the fact that rural communities are involved in managing their own potable water systems.

The municipal management model is a strategy where potable water is supplied, directly or indirectly, by a municipality (Lockwood and Smits, 2011). Countries that use this model include, Switzerland, Colombia, and Latin America and some countries in Africa, including South Africa. There have been a few successful management incidences of potable water supply, using this method in rural areas. The weakness of the model is that communities are passive recipients of service.

Lockwood and Smits (2011) indicated that a privately – owned management model is a strategy in which the private sector invests in building and operating water supply systems to serve communities; governments encourage this arrangement when they cannot provide potable water. This model is being used in Paraguay, Benin, Kosovo, and Senegal, and Nigeria. The advantage is that providers transfer water supply infrastructure and skills to communities to run their potable water supply.

Self-supplying is a method in which individual households provide for their own water (Moriarty *et al.,* (2013). This a procedure where individual households fill a gap where a government is unable

to reach all communities to provide potable water supply. This method is practiced in places like Zimbabwe and Bangladesh, where rural communities are scattered. The advantage is that individual households managed their water systems. Non-Governmental Organizations (NGOs) also play a meaningful role in potable water supply in rural areas. Various NGOs are involved in water supply projects within rural communities in South Africa. These NGOs include, Mvula Trust, Association for Water and Rural Development (AWARD), Water Dialogues South Africa (WDSA), and Association Programme-Norwegian Agency. They strengthened the people-centred approach in operation and maintenance of potable water supply in rural areas (Cothren, 2013). These donors assist the municipalities by providing expertise and resources for potable water supply systems in rural areas.

2.11 The role of rural communities in the management of water supply systems

Legislatively, community participation is accepted as a critical component in water resource management (Baokye & Oghenerobor, 2012), however, the water authorities lack capacity to engage communities as well as transfer skills regarding water resources to them (Hove *et al.,* 2018); this is true of the Vhembe District Municipality. According to Choi *et al.* (2017) the roles of rural communities involve sharing the cost of the available water and the sustenance of water services. These if implemented, go a long way in improving water supply services in a given area. Da Silva *et al.* (2013) emphasise on rural communities engagement in order to enhance sustainable rural water supply, as well as build their capacity through training of households. In addition, capacity-building of communities in monitoring and assisting in the operation and maintenance of water project is one of the sustainability criteria. Capacity-building is necessary as rural communities lack technical expertise needed to operate and maintain water infrastructure.

Durability of water supply systems and the ability to adapt to customers' changing needs and preference for quantity and quality of water, have been an area of concern for many years and in many communities. Rural communities when they are actively involved can contribute to the better performance, in terms of their preferences and their needs which will increase the success rate of the water schemes (Da Silva *et al.*, 2013). Furthermore, when communities participate directly in planning their own water supply system, the system is more likely to be sustainable than when imposed by the municipality or donors. Communities that participate or engaged in planning, designing and implementation processes are more likely to select supply options they are willing and able to operate and maintain (Da Silva *et al.,* 2013). For the effectiveness of rural water supply system, the system should be community-driven as when communities, government

and private providers get together the water supply systems perform well. The collaboration between government, private sector and rural communities need to be facilitated by government and local government administrators.

Shared-understanding and dialogues with communities about water project and infrastructure options, ensure that communities' preferences for service level and type are ascertained. This also encourages identification of communities' preferences and responsibilities for financing operations and maintenance (Da Silva *et al.* 2013). The role of communities in water projects is to ensure that there is social-capital which helps communities to develop and deploy its own administrative and financial capacity to manage the system. In addition, active ongoing communication between local leaders and communities, regarding the planning and operations of water system, helps engender trust essential for social-capital building; this also generates a willingness to pay, for water services, by the households. Availability of equipment, administrative and financial capacities ensures that the water system operates effectively over time, and at reasonable costs.

According to Mogane - Ramahotswa (1995) to obtain optimum results, communities active involvement in payments, operation and maintenance is important in the development of appropriate water supply systems in rural areas. To obtain optimum results in water projects, it is essential for government to raise communities' consciousness at grass roots level, rather than to impose the system on them. In addition, communities' self-initiated water projects with strong back-up support from development agencies are prone to success than project initiated and implemented from outside.

Mugumya (2013) writing on Uganda, confirmed that operation and maintenance successes are due to rural water facilities managed by community-based organisations and supported by local government and are decentralised to communities. In addition, in such circumstances, households are mobilised, sensitised and supported to run water projects in their areas. Hand-pump mechanics and plumbers in the areas, where possible, are used for to do repairs; servicing and preventive maintenance of water system are then supervised by district officers, in line with policy framework. Contracts are signed with plumbers and mechanics to report and handle basic hand-pumps' breakdown. The role of rural communities, according to Mugumya (2013), are - to run water supply system, do operation and maintenance, meet regularly, collect funds for operation and maintenance, ensure hygiene at water sources, formulate and enforce by-laws - and these ensured high sustainability in Uganda. When communities have functional governance

committees, the water supply systems suffer minimal or no breakdown of water systems. The other role of communities, through their governance, is to ensure regular assessment of the functionality of the system, including sources and whether they are working normally and yielding adequate volume of water.

A study by Bayene and Luwesi (2018) reveal that weak communities' participation in water affairs is one of the reasons financing for sustainable development is not taking place. Rural communities need to play their roles in financing operations and maintenance of infrastructure in their areas. The other way to address rural water supply, according to this report, is for communities, private sector and government joining hands to form public-private partnership to address water sources and related problems in rural communities. To ensure availability and accessibility of water, there should be innovative approaches agreed upon with communities and other water users to manage water schemes. In addition, the study found that for rural water to be effectively delivered, rural communities need to be willing and encouraged to pay.

Bazaanah (2019) reveals that in Ghana, decentralisation and participatory democracy has been attributed to successful rural-water project implementation. The study continues that householders' sense of ownership, positively and significantly increases communities' confidence in water services and sustainable water management. In addition water projects initiated only through community-level organisations have low user-confidence levels. The water supply problems should be community-driven and that should be facilitated by the government or municipalities. Support from rural communities increases trust in the government and encourages cooperation and working together. Broader consultation of all stakeholder, hence, helps to encourage participation and resolve water issues, promptly. The findings also revealled that an educated community, trained and well-informed population promote friendy attitudes and adaptation of lifestyles aimed at conservation and certain livelihood activities in communities; this enhances quantity and quality of water service.

The study by Omarova *et al.* (2019) and Hutton (2016) in India recommended decentralisation of water supply systems to rural communities, for them to plan, manage and implement. Cooperation between government and communities, including all stakeholders, has been a success factor in India rural water supply projects. When stakeholders share project it is easy to identify sustainable problems, develop and implement policies that enhance the water project. Mandara *et al.,* (2013) study in Tanzania revealed that the role of communities include - management of the water services, cleaning around the boreholes and water tanks and carrying minor

maintenance. The authors add that each village buys spare parts for minor replacement and each village also has its own trained technicians, pump and tank attendants. There is also a water-point register where time and type of breakdown is recorded, including the last time maintenance was done.

2.12 Summary of the Review of Literature

The literature reviewed highlighted that the poor state of potable water supply is still a significant challenge globally and this requires attention to make the system work effectively and efficiently. There were discussions on water supply systems sources used and how households cope during supply challenges, globally and also regionally. This analysis helped to point out necessary water improvement measures used and made a comparison in order to devise interventions to improve the water supply systems for the VDM.

In the developing countries and particularly South Africa, potable water supply does not meet the demand of the majority of the rural communities. The statutory requirements, such as Water Service Act, 108 of 1997, Water Act, 36 of 1998 and other related water-supply policies were developed to address the issue under study, however, the progress made in intervening in the situation was not encouraging. The key challenges identified from the available literature include - aging infrastructure, lack of funding models, lack of capacity in the municipalities and lack of political will, to create an enabling environment for better service delivery among the rural communities. The need to involve rural communities in design, management and monitoring is critical to ensure households' ownership of water projects.

The fact that potable water supply in South Africa and other developing countries does not meet the demand of the majority of rural communities was stressed. In some countries, although, plans are available on how potable water supply systems should be made available to households, they are not acted upon; this is caused by poor leadership and management, leading to inadequate water supply. Policies and legislations are available in many countries of the world, according to reviewed literature, however, there has been limited progress in providing potable water to households. Non - alignment of water supply in municipals' Integrated Development Plans (IDP) process, budget-formulation difficulties, and other related issues, further compromised the issue.

CHAPTER 3: RESEARCH METHODOLOGY

3.1. Introduction

This chapter presents the methodology of the study. In the presentation, the study area and the research design is described and the population and sampling procedures used are explained. Also contained in this chapter are the methods, tools, and techniques used to collect and analyze data, and the ethical considerations applied in the study. Finally, a table summarising the data collection and analysis process is provided.

3.2. Description of the Study Area

The study was carried out in some rural wards within the four local municipalities that form the VDM in Limpopo Province, South Africa (Figure 3.1). Vhembe District Municipality was established in 2000 based on the Local Government: Municipal Structures' Act 117 of 1998 (Vhembe IDP, 2010) and the Local Government: Municipal Systems Act of 2000. Rural areas constitute most parts of the District. Four local municipalities, namely, Musina, Thulamela, Makhado, and Collins Chabane (the newly-named municipality covering the Malamulele area) (Vhembe District Municipality IDP, 2009). The District is the former severely-underdeveloped Venda and Gazankulu "homelands" established during the apartheid era, in South Africa in terms of the Black Authorities Act (68 of 1951).

The study area's population was 1.4 million people at the time of data collection, who were distributed in 382 358 households (STATSSA, 2016). The District's political, administrative, and commercial center is located at Thohoyandou, within the Thulamela Local Municipality (Vhembe District IDP, 2017/18 - 2021/2022). Thulamela Local Municipality has the highest number of wards (41), followed by Makhado Local Municipality (39), the newly-formed Collins Chabane Local Municipality (36), and Musina Local Municipality with only 13 wards. The Vhembe District Municipality continues to struggle to overcome a massive backlog in the provision of essential services, including provision of potable water to rural communities (Vhembe District Municipality IDP, 2009)

Figure 3.1: Vhembe District Municipality Map,

Source: www.muncipalities.co.za (Coordinates: 22°56'S 30°28'E)

3.3. Research Design

De Vos (2013) clarifies a research design as a plan, structure, and strategy to guide investigation to find answers to questions and problems. A descriptive design was used in this study to obtain information and provide details of the project. Polit and Beck (2004) explain that a descriptive study explicates and documents the state of things as they happen. Bless and Higson – Smith (2000) posite that applied research focuses on finding solutions to specific problems facing particular groups of people.

The mixed-research design approach, which combines quantitative and qualitative methods, was used in the study. The mixed method is used to confirm or contradict conclusions made from both qualitative and quantitative methods. The qualitative approach helped bring out the participants' views that allowed for a more productive exploration of cause and effect and, ultimately, the development of key themes (Chetty and Luiz, 2014). The quantitative design was used to examine relationships statistically amongst variables. Creswell (2014) also confirmed that quantitative methods help quantify the magnitude of associations or relationships with the study problem.

The reason for using a mixed-method design was to ensure that the other methods' weaknesses can be compensated. The study required qualitative data from responses that are not pre-determined, and the quantitative data required closed and open-ended responses to come up with a complete and transparent research data that compensates for the limitation of the other method. Triangulation of methods and data sources were used to seek convergence across the qualitative and quantitative methods. In the study focus-group views and households', councilors', and municipal officials' views were triangulated to validate the responses.

3.3.1 Population and Sampling Procedure

The study population consisted of 382 358 households. The research was conducted among household heads and water supply system stakeholders, such as traditional leaders, and councilors from rural areas of the four local municipalities in the Vhembe District Municipality, and officials responsible for water supply in Collins Chabane, Makhado, Thulamela, and Musina Local Municipalities.

A multi-stage sampling procedure was used to select the individual respondents' from the local Municipalities, wards, villages and individual households as shown in Table 3.1. Of

the 129 wards in the VDM, 96 are rural, which were then purposeively selected due to their rurality, which was a selection criterion for the study. The rural wards were distributed as follows: 29 in Thulamela Local Municipality, 7 in Musina Local Municipality, 25 in Makhado Local Municipality, and 35 in Collins Chabane Local Municipality.

Out of the 96 rural wards, fourteen wards were selected using proportional representation, and 14 villages were then purposively selected. Davies (2007) argued that purposive sampling enables a researcher to choose participants with the best information to achieve a study's objectives; thereafter, a proportional representation process was used to select specific villages in each ward for the study. The selection of the villages was based on the following characteristics: the villages which are rural and with persistent water challenges. It was assumed that the villages affected most by water supply challenges would provide more relevant responses for this study; these villages were selected using snowball sampling.

Proportional apportionment of the respondents was used to ensure that vilages with large populations contributed more respondents who were then invited to participate in focus-group discussions. Then simple random sampling was used to select households from each village and this resulted in 448 household heads being selected, to take care of any non-responses and cases whereby some respondents would drop out of the research, mid-way.

The number of household heads to be sampled was calculated using the Yamane (1967) sample calculator which is as follows:

Sample size = Total population ÷ (1+ total population) x $(e)^2$

Sample = 382 358 ÷ (1 + 382 358 x $(0.05)^2$

= 382 358 ÷ (1 + 955.895)

= 382 358 ÷ 956.895

= 399.58

= 400.

The total number of households who formed the population of the study was 382 358 based on the national households' survey statistics (STSSA, 2016). Using Yamane's

formula, 400 households were initially selected but was then increased by 50 to 450 households to cater for non-responses possibilities. Two returned questionaires were declared invalid and the study was conducted with 448 households.

Focus-group discussion participants in each village were selected through simple random sampling with each group consisting of 8 to 12 household heads. Simple random sampling was used to ensure that all the participants had an equal chance to participate in the group-discussion process. The population and sampling procedures for the households are summarized in Table 3.1

Table 3.1 Population and Sampling for the study

Vhembe District Municipality	**Total No. of wards**	**Rural wards**	**Wards No. sampled**	**Name of the villages**	**Population per village**
Thulamela	41	29	01	Tshixwadza	1117
			04	Tshidongololwe	939
			15	Tshandama	1687
			26	Mangaya	1355
Sub – total			04		**5098**
Musina	13	7	10	Mbodi	885
Sub total			01		**885**
Makhado	39	25	24	Madabani	1010
			36	Mavhunga	1041
			25	Midoroni	1140
			12	Mashamba	765
Sub total			04		**2946**
Collins Chabane LIM 345	36	35	01	Akani	1070
			04	Mahathlani	1218
			09	Kurhuleni	1288
			19	Khakhanwa	700
			12	Dovheni	670
Sub total			05		**4946**
Total	129 wards	96 rural wards	14 wards	**14 villages**	**13875 households**

Source, (Survey, 2019)

The second group of participants were the key informants who were the municipal officials responsible for water quality, municipal officials for operations and maintenance as well

as municipal officials for technical services, who were purposefully sampled. These three category of officials were crucial because they had institutional memory of the municipality, thus, they were expected to provide an overall insight of the challenges relating to potable water supply and the systems of delivery in the Municipality.

All councilors within the sampled wards in the Municipalities were participants in the study, and they were purposefully sampled. All the 14 ward councilors were part of the study and were given questionaires to complete. All traditional leaders from the 14 villages were also selected through a purposive sampling method to be part of the focus group with the households and councilors in each village in a municipal ward. The aim was to establish if the responses in the quantitative approach are consistent with those obtained through the qualitative approach. The appropriateness of the questionnaires was pre-tested among similar members who were not part of the final study.

3.3.2 Data Collection Process

Permission was obtained from the municipal manager of the Vhembe District Municipality to conduct the study. The Municipality provided the researcher with an official to assist in the study, and this made access to the villages and households seamless and easy. Dates were set, and traditional leaders' palaces were the venues where data collection took place, except in two villages where the local churches were used. An information sheet, including a consent form, was provided to each participant, and the purpose of the study was explained to all participants. All respondents were informed that they were not allowed to disclose their identity or any identifiable information when answering the research questions. They were also told that they can withdraw from the study any time, since the study is voluntary.

The researcher appointed two research assistants with the help of the University to assist in the distribution of the questionnaires, recording of the interview sessions, and also taking pictures and notes during data collection. Both primary and secondary data were collected. The secondary data was obtained from various sources, including municipal records, research publications, government documents, and reports. These were used to get background information (literature review), and a deeper meaning of the phenomenon.

Through informant interviews, in-depth information was collected from the senior administrators (key informants) of the VDM, who are municipal officials, using an interview

guide. A focus-group discussion guide was also used to gather data from households, councilors, and traditional leaders; this method was used to collect the qualitative data. The number in the focus groups depended on the number of participants, whereby, the more the participants in the village, the more the number of groups to be engaged.

In total, 14 focus-group discussions were held in 14 villages in local municipalities with between 7 and 10 respondents in each group. Questionnaires were distributed to collect data from the heads of households and councilors from each of the local municipality. Councilors and traditional leadership, as well as household heads, hence, were part of the focus-group discussions. The interview notes and recording, including questionnaires, were safely kept for security reasons.

3.3.3. Data Analysis

Qualitative data were analyzed using thematic content analysis, and quantitative data used Statistical Package for Social Sciences (SPPSS) version 25, specifically, for the data analysis. Quantitative data were analyzed using descriptive statistics. According to De Vos *et al.* (2011), both styles of data analysis entail the following: (a) *inference*, meaning, reasoning and conclusions about the empirical data gathered; (b) a *process* involving documentation of data analyzed and how the analysis was done, (c) *comparison*, implying that social researchers compare features of evidence they have gathered internally or with related evidence and lastly (d) *evident and deliberated efforts* aiming to reduce errors.

For the quantitative data analysis**, v**iews from the head of households and councilors were analyzed using SPSS version 25. Raw data was first coded by hand, according to the measurement levels then captured on a Microsoft Excel 2013 spreadsheet, allowing it to be exported to SPSS (Statistical Package for Social Sciences). Data were analyzed using the SPSS version 25. Descriptive statistics were used to analyze the quantitative data, which involved the use of frequency counts and percentages. ANOVA one way was used to test if there is a significant relationship among the variables in the study. A Chi-Square test was used when the quantitative data was analysed, to calculate significant differences in the perceptions of rural dwellers in VDM on water provision services based on the Municipality, source of water, and location of the primary water source. Cramers V test was also used to test the type of relationship between variables after carrying the Chi-

Square test. Results of Chi-Square were used to test the hypothesis by accepting or rejecting, depending on the hypothesis's nature.

The Kruskal-Wallis Test through ANOVA one way (Non-parametric ANOVA at 95% level of significance) was used to compare the scores on the scales of the levels of satisfaction on the various aspects of water provision by the different Municipalities and scores on the scales of the levels of satisfaction on the various aspects of water provision based on the different water sources used. The data analysis allowed the researcher to order and organize research data so that useful information can be extracted from it. Data were first analyzed using a quantitative approach, and after that, the qualitative approach was used to confirm, dispute or get more in-depth information on the topic under discussion. The process of organizing data was key to understanding and bringing answers to the research questions (Smith and Albaum, 2012).

The qualitative data analysis was done through the thematic content method, outlined below (Table 3.2). The analysis done through the thematic content method, followed the steps outlined - becoming familiar with data by reading and rechecking any significant meaning or pattern; codes were generated; coded data were sorted into themes which were summarized; these themes were then categorized, compared, and analyzed. This procedure followed the view suggested by Baun and Clarke (2006), who advocated for the data to be organized into themes before being analyzed.

Table 3.2: Summary of the Research Methodology

Research Objectives	Research questions/issues	Sampling method	Data sources	Data collection techniques/tools	Types of data	Data analysis techniques/tools
To determine existing potable water supply systems sources in rural communities of VDM	What is the extent of water supply systems in rural communities of VDM?	Purposive, snowball and simple random	Communities (households) traditional leaders, councillors and relevant documents	Focus-group guide, structured questionnaires, and relevant documents' review.	Primary Secondary	Thematic content (themes), descriptive statistics, ANOVA one way and Chi - Square.
To examine the effectiveness of current intervention strategy of rural water supply systems in VDM	How effective is the current intervention strategy of water supply systems, in Vhembe District Municipality, in relation to rural communities?	Purposive, snowball and simple random	Communities (households), administrators, traditional leaders, councillors, and relevant documents	Focus-group guide, interview guide, questionnaires guide and relevant documents' review	Primary Secondary	Thematic content analysis, descriptive statistics, Chi – Square and ANOVA one way.
To identify coping strategies and challenges in water supply systems in VDM	What are the challenges and coping strategies in dealing with water supply concerns in VDM?	Purposive, snowball and simple random	Communities (households), administrators, traditional leaders, councillors, and relevant documents	Focus-group guide, interview guide, questionnaires guide, and documentary review	Primary Secondary	Thematic content (themes), descriptive statistics (frequency distribution (%).
To propose appropriate intervention strategies for effective water supply to rural communities.	What suggestions can be made to improve the effectiveness of rural water supply service in Vhembe District Municipality?	Purposive, snowball and simple random	Communities (households), administrators councillors, traditional leaders, and relevant documents	Focus-group guide, interview guide, questionnaire guide, and relevant documents' review	Primary Secondary	Thematic content, descriptive statistics.

3.4. Ethical Considerations

Before the commencement of the study, clearance was obtained from the University of Venda Ethics Committee and permission to conduct the research was obtained from the Vhembe District Municipality. The code of ethics required, as well as written permission to conduct the study, were obtained. In line with De Vos *et al.,* (2002), the following key ethical principles underpinned the study's execution:

Assurance of research integrity meant that care was taken to ensure that the study was executed truthfully, transparently, and competently. Care was taken to produce scientifically sound, verifiable, and repeatable results. For example, the researcher ensured peer review of all aspects of the research study through consultation with his study leaders, other senior researchers, and relevant stakeholders in the research community,

Avoidance of social, emotional, and physical harm to research participants was implemented through obtaining informed consent for the research interviews/observations from the research participants and relevant authorities in the research community. Cognizance was taken of De Vos *et al.* (2005)'s submission that in obtaining informed consent implied that all possible or adequate information on the goal of the investigation, the possible advantages, disadvantages, and dangers to which respondents may be exposed, as well as details on the credibility of the researcher, be rendered to potential subjects. Emphasis was placed on accurate and complete information so that the participants fully comprehended to ensure that they could consequently make a voluntary, thoroughly reasoned decision about their possible involvement.

The study also ensured confidentiality of the specific data provided by the research participants and their voluntary participation. Care was also taken to gather and analyze the data without any direct value judgment of the research participants' actions and points of view. In short, special care was taken to ensure, as far as possible, that the basic human rights of the persons and agencies participating in the study are respected, hence, full ethical principles for research, were observed.

CHAPTER 4: THE CURRENT POTABLE WATER SUPPLY SYSTEMS SOURCES IN RURAL COMMUNITIES OF VDM

4.1 Introduction

This chapter focuses on the data presentation, analysis, and discussion relating to the study's objectives, based on the current potable water supply systems in rural areas of the Vhembe District Municipality. The findings were drawn from issues on - the main water sources, frequency of water received, satisfaction with water supply services and information related to distance to water sources and their quantity and reliability, as well as community participation in the offering of water services. The biographical information of participants is also outlined and finally, a conclusion is provided.

4.2 Demographic profile of the respondents

The distribution of the respondents by municipality is presented in Table 4.1. The total number of participants, household heads, was 448. Out of the 448, about 35.7% were drawn from the newly-formed Collins Chabane Local Municipality (LIM 345); 28.6% were from Makhado Local Municipality; 7.1% were from Musina local Municipality, and 28.6% were from Thulamela Local Municipality.

Table 4.1: Distribution of respondents by Municipalities

Municipality	Percent (%)
Collins Chabane	35.7
Makhado	28.6
Musina	7.1
Thulamela	28.6
Total	100.0

Source: (Survey, 2019)

The results from Table 4.2 show that the majority of households in the Vhembe District Municipality are headed by females, since the majority of the males are migrate-workers seeking

job opportunities outside the Vhembe District Municipality. The results concur with the study conducted by Mpandeli (2006).

Table 4.2: Gender distribution of the sample of the study

Gender of participants (Households Head)	Percent
Male	42.9
Female	57.1
Total	100.0

Source: (Survey, 2019)

The results from Table 4.3 show that the age distribution in the VDM varies between 12.1% and 45.3%. The majority of the respondents are between the ages of 30-39 years which is 45.3%, and 12.1% in-between the ages of 18 – 29 years (Table 4.3). The councilor respondents were 30% females and 70% males.

Table 4.3: Age distribution of the respondents in the sample

Age of participants	Percent
18-29yrs	12.1
30-39yrs	45.3
40-49yrs	29.7
≥50yrs	12.9
Total	100.0

Source: (Survey, 2019)

The educational status of the respondents is presented in Table 4.4. The status of the participants was fairly balanced, because 22.3% had primary school education, 31.9% had reached secondary school level, and 32.4% had matriculated while 10% had tertiary level of education, and 2.2% had post-graduate degrees. Only 5 participants, about 1.1%, did not have any qualification.

Table 4.4: Distribution of respondents by education level achieved

Level of education	Percent
None	1.1
Primary	22.3
Secondary	31.9
Matric	32.4
Tertiary	10.0
Postgrad	2.2
Total	100.0

Source: (Survey, 2019)

Table 4.5 presents the distribution by the size of the household. Most respondents' households had more than four people (about 42.9%) per household, followed by those with only four people per household at 35.5%; about 17.0% of the respondents had three people in the house and households with only two people were 4.7%. From the results, it is clear that the average household size in VDM is four in each household, as was indicated by about 78.4% of the respondents.

Table 4.5: Distribution by household size in sample

Household size	Percent
2 people	4.7
3 people	17.0
4 people	35.5
>4 people	42.9

Source: (Survey, 2019)

4.3 Discussion of Results

This section presents the results, analysis, and discussion on existing sources and potable water supply systems available in the research areas.

4.3.1 Main water sources in local Municipalities of Vhembe District

As outlined in Table 4.6, the main sources of water in the VDM are boreholes; this was mentioned by about 45.3% of the respondents, followed by piped water from the dams mentioned by about 35.3% of the respondents. Boreholes (45.3%) are the most common water sources in rural areas showing that communities rely on underground water for survival in.

The main sources, according to household heads were boreholes used in Musina Local Municipality (100%) as the main source, followed by Makhado Local Municipality at 56.3% and 48.8% in Collins Chabane Local Municipality. Dams were also used as another source of water supply; 50% of people in Collins Chabane Local Municipality (LIM 345) use dams as their main source, followed by Thulamela Local Municipality by 42.2%. Only Thulamela Local Municipality communities use rivers as the main source by 14.1%; fountains are used as the main water source in Thulamela Local Municipality by 18.8%. In Makhado Local Municipality, 25% of households used water tankers (truck tankers) as the main source, followed by Thulamela Local Municipality by 8.6% of the people and Collins Chabane Local Municipality by 1.3% (Refer to Table 4.6).

In Makhado Local Municipality, the majority of the people use boreholes as their main water source; in the Municipality, there ware three options: boreholes, piped water from dams, and water tankers. Of serious concern in Makhado Local Municipality is the use of water tankers as the main source, according to 25% of the respondents, which indicates that water supply is in a bad state and needs urgent intervention. Water tankers are only used in an emergency when the main sources are dysfunctional.

Table 4.6: Main Sources according to the Local Municipalities of VDM

Main Source		Collins Chabane	Makhado	Musina	Thulamela	Total
Boreholes	(%)	(48.8)	(56.3)	(100)	(16.4)	(45.3)
Dams	(%)	(50.0)	(18.8)	(0.0)	(42.2)	(35.3)
Rivers	(%)	(0.0)	(0.0)	(0.0)	(14.1)	(4.0)
Fountain	(%)	(0.0)	(0.0)	(0.0)	(18.8)	(5.4)
Water Tankers	(%)	(1.3)	(25)	(0.0)	(8.6)	(10.0)

Source: (Survey, 2019).

In Thulamela Local Municipality, the majority of households depend on piped water from the dams (42.2%); about 18.8% of respondents indicated their main source as fountains, while about 16.4% of the respondents indicated that their main sources of water are boreholes. From these results, it is strange that the second most used water source in Thulamela Local Municipality after piped water from dams is the fountains (18.8%); This is of a serious concern, as fountains as sources of water are not protected and also not formalized.

The positive side of the results on Thulamela Local Municipality is thatcommunities have all five water source options, which, if managed well, can relieve households, providing them with water consistently. The use of fountains and rivers as other sources is of serious concern as these sources are not immune to contamination, thus, they are serious health risks. Communities may end up contracting waterborne diseases because most fountains and rivers are not protected sources of water. Consequently, Tshikolomo *et al.,* (2012) reiterate that using less safe water sources is dangerous to our health, and this calls for an urgent address.

Collins Chabane Local Municipality has three source options; the main water sources were piped water from the dams according to 50% of the respondents, followed by about 48.8% who mentioned boreholes as their main source. Collins Chabane Local Municipality is situated next to the newl- built Nandoni dam, and that is why they mainly use piped water.

In Musina Local Municipality, 100% of respondents indicated that the main source of water is the borehole. This indicates that the Musina Local Municipality has only one source option, which might be problematic in times of breakdown; this would leave communities stranded. There is a need for more source options to be introduced so that when one option breaks down, another one supplies water to communities. The results are consistent with findings by Emmanuel and Bamidele (2015) which concurred that in most countries' rural communities, boreholes are the main sources of water supply.

The results show that VDM has adopted a mixed options for supplying water made up of - ground water, pipeline, rivers, tankers and fountains as championed by the national government. This strategy will assist the VDM to address the water security issues in a sustainable manner, therefore, will contribute towards the achievement of some of the Sustainable Development Goals, especially, goal number 6.

4.3.2 Quantity of water received from main source

Most focus-group discussants disclosed that the quantity of water received was estimated to be about 100 liters to 2000 liters per day, when water is available. One focus group discussants revealed that they received less than 100 liters of water from fountains and 360 liters from the rivers. The focus-group discussants (councilors, households heads, and traditional leaders) indicated the following:

"We collect at least less than 100 liters of water from the main source per day".

This observation was the case in almost all the four local municipalities, as the focus groups discussants revealed. The conclusion is that the quantity of water received by communities from the primary sources is inadequate as it does not meet the minimum requirements of 25 liters, per person per day (Water Service Act, 1997). This is evidence that people have inadequate water supply and are at risk of infections, as they resort to using water from unprotected sources.

The study results show that receiving less than 100 liters of water per day is not enough, as this means, there are people who receive less than 25 liters, per person, per day. In this situation, the water received is not enough for households with an average family of four and more. The households of 78.4% of respondents have four or more members per household (Refer to table 4.5). When the water quantity received is not enough, as per the legislative requirement, it is a

serious concern as the people's standard of living is compromised and negatively affects the communities' health status (PAHO, 2011 and WHO, 2014).

4.3.3 Frequency of water from the main water sources

The study's findings show that households have access to water on the average, once a week (Table 4.7). The majority of the household heads who participated in the study indicated that they accessed water once a week (53.6%), and 30.1% indicated that they accessed water daily. Of concern was the fact that there was a significant proportion of households that indicated that they accessed water at least once a month (14.7%), once in six months (1.3%) and once per year (0.2%) (Table 4.7).

Table 4. 7: Frequency of use of the main water source

Frequency of use	Percentage
Daily	30.1
once a week	53.6
once a month	14.7
once in 6 months	1.3
once per year	0.2
Total	100.0

Source: (Survey, 2019)

The primary sources of water from the Municipality were the boreholes and the piped water from the dam. Another concern is that the water supply service is always interrupted by the frequent breakdown of machinery. In terms of the water supply standards, the interruptions should not last more than 48 hours (Water Service Act, 1997). The other cause of lack of water is that demand exceeds supply, due to drought and population increase. Mothetha, Nkuna, and Mema (2013) and Basson (2012) echoed the same sentiments when they said that municipalities still suffer from lack of reliable water supply due to population growth and droughts.

4.3.4 Level of satisfaction with water provision services

The Kruskal-Wallis test was used to compare the scores on the scales of satisfaction levels on the various aspects of water provided by the different municipalities. Significant differences ($p < .05$) were reported in all the six aspects measured to determine the levels of satisfaction with the water provision services in the four municipalities in VDM (Table 4.8).

On, satisfaction with the quantity of water provided, the Makhado Local Municipality respondents were the least satisfied (with a mean score of 3.09). The Makhado Local Municipality is a water-scarce area where the majority of boreholes have dried up; some need to be maintained, while very few were operational. Respondents in Musina Local Municipality were the most satisfied (with a mean score of 4.41) as they were receiving water daily. When it comes to satisfaction with the quality of water provided, the Musina Municipality residents were the least satisfied (mean score of 1.13), and this is due to the salty groundwater in the area; their view was that the water is not safe for drinking as it is of poor quality.

Makhado Local Municipality residents were the most satisfied in terms of water quality received (mean score of 5.45), and this was because their water sources are safe for drinking as they are protected from contamination. In terms of satisfaction with the distance travelled to collect water, residents of Collins Chabane Local Municipality (LIM 345) and Musina Local Municipality were the most satisfied as indicated by their ratings of the service (average score above 5) (Table 4.8) and this was because most villagers travel less than 200 meters to get water from the main sources. The Makhado Local Municipality residents were the least satisfied (mean score of 3.48) and also Thulamela Local Municipality with a mean score of 4.23 on the distance travelled to get water which was beyond 220 meters as per the national standard requirements (Water Service Act, 1997 and FBWSP, 2000); they had to travel long distances to collect water from the boreholes or the water tankers.

Collins Chabane Local Municipality (LIM 345) residents were the most satisfied (mean score of 6.98) as the distance to the water point was within 200 meters from the households. All the local municipalities were satisfied with the quality of their alternative source/s (mean score ratings above 5) except Musina Local Municipality residents (mean score rating of 1.28). The dissatisfaction of Musina Local Municipality residents stems from the salty water they receive from the boreholes in the area. Cothren (2013) attests that rural communities of VDM were not satisfied with the water they received, and Noga and Wolbring (2015) argued that communities are satisfied when they received quality water supply daily, at a reasonable distance from their

households. All the local municipalities were dissatisfied with the quantity of water received per day, as their mean scores were less than 5.

When it comes to the system's reliability, only the Musina Local Municipality residents were satisfied with their water supply's reliability (mean score rating of 8.19) as they collect water daily from their main source. In contrast, the other three local municipalities were not satisfied (mean score rating below 5 (Table 4.8) as water is not consistently supplied in most parts of the municipalities. Respondents from all the four local municipalities reported satisfaction with the participation of communities in domestic water supply services. (Refer to Table 4.8 below).

Table 4. 8 The level of satisfaction with water provision services

Variables	Collins ChabaneR Mean (SD)	Makhado R Mean (SD)	Musina R Mean (SD)	Thulamela R Mean (SD)	Significance
Quantity satisfaction	4.25(2.66)	3.09(1.10)	4.41(0.76)	4.26(2.17)	< 0.0001**
Quality satisfaction	4.79(3.06)	5.45(1.64)	1.13(0.34)	4.23(1.92)	< 0.0001**
Distance satisfaction	6.98(2.31)	3.48(1.10)	5.47(0.57)	4.23(1.92)	< 0.0001**
Quality of alternative	6.93(2.36)	5.12(2.80)	1.28(0.68)	5.55(2.09)	< 0.0001**
Reliability of system	1.37(0.48)	3.22(1.45)	8.19(0.64)	4.07(1.74)	< 0.0001**
Community involvement	5.29(2.55)	5.5(1.10)	6.69(1.0)	6.59(1.83)	< 0.0001**

Source: (Survey, 2019), Significance level: * P<0.05, ** P<0.01. R= Rank

4.3.5 Level of satisfaction with the sources of water according to household head

The Kruskal-Wallis test was used to compare the scores on the scales of the levels of satisfaction, on the various aspects of water provided by the different water sources used. Significant differences (p< .05) were reported in all the six aspects measured to determine the

levels of satisfaction with the water provision services, based on the source of water used in VDM (Table 4.9). Regarding satisfaction with the quantity of water provided, users of boreholes, dams, and rivers expressed dissatisfaction (mean score rating below 5 (Table 4.9). This dissatisfaction was because they did not receive water on a daily basis, whereas users of springs/wells and water tankers expressed satisfaction (mean score ratings above 5).

The findings in Table 4.9 show that the boreholes and river-water users were not satisfied with the quality of water (mean score ratings below 5), whereas users of dams, fountains and water tankers were satisfied (mean score ratings above 5). Some households did not understand the meaning of 'water quality', however, the users of water tankers were the most satisfied (mean score of 8.0). When it comes to satisfaction with the distance they travelled to collect water, users of dam water, fountains, and water tankers were satisfied with the distance they travelled (mean score ratings above 5) compared to users of the borehole and river water who were not satisfied with the distances they had to travel to collect water (mean score ratings below 5) (Table 4.9). Users of all the water sources, except borehole users, were satisfied with the quality of their alternative sources (mean score ratings above 5). Regarding reliability, river water, and fountain/spring/well water were reported as reliable (mean score rating above 5), whereas, borehole, dam water, and water tankers were reported as unreliable (mean score ratings below 5).

Table 4.9: The level of satisfaction with the source of water used

Variables	Borehole R-Mean (SD)	Dam R-Mean (SD)	Rivers R-Mean (SD)	Fountain R-Mean (SD)	water tanker R-Mean (SD)	Significance
Quantity satisfaction	2.90(1.69)	4.67(2.3)	4.89(0.58)	6.63(0.9)	5.58(1.9)	< 0.0001**
Quality satisfaction	2.60(1.42)	5.81(2.17)	4.94(0.24)	6.08(0.4)	8.0(0.88)	< 0.0001**
Distance satisfaction	3.97(1.83)	6.13(2.74)	4.94(0.24)	6.08(0.4)	6.0(1.80)	< 0.0001**
Quality of alternative	3.46(1.95)	7.06(2.07)	6.28(0.46)	7.75(0.8)	8.8(1.08)	< 0.0001**
Reliability of system	2.71(2.58)	2.55(1.07)	5.39(0.50)	6.0(0.0)	4.87(1.4)	< 0.0001**
Community involvement	4.26(1.65)	6.73(1.12)	7.67(0.49)	8.42(0.5)	7.56(1.2)	< 0.0001**

Source: (Survey 2019), Significance level: * P<0.05, ** P<0.01. R = Rank

4.4 Conclusion

The results reveal that existing potable water supply sources in VDM's rural areas are boreholes, dams, rivers, fountains, and water tankers. The state of water supply in VDM is inadequate as there are communities that go without water for several months, if not years. Water is regarded as a fundamental basic right protected by both international and national laws, as such, it should be availed to all citizens without fail, at all times. In terms of national and international standards, VDM is failing to provide consistent water to its rural communities as the sources available were not enough to cater for the increasing population. For this reason, many rural communities are still unable to access water as required. Most water sources in VDM are safe for drinking, except for sources like rivers and fountains, however, a significant number of residents still use these unreliable sources, although, they have significant risks to health and may even cause death.

The distance to water sources was still long for some municipalities like Thulamela and Makhado Local Municipalities, hence, people in these rural communities have to walk long distances to collect water. This impacts negatively on their time to perform other essential household chores;

this particularly affects women and children as they are the main drawers of water. Water points are supposed to be within 200 meters from households, according to the Water Service Act (1997) and Department of Water Affairs (2013). This, however, is still a dream to many communities.

The quantity of water is not enough to cater to households' needs. This forces residents to search and collect water from unreliable sources, like fountains and rivers, which have potential health hazards. The current water supply systems in VDM, do not meet the quantity of water required per day of about 25 liters, per person per day, as most rural communities receive water twice per week, except for Musina Local Municipality residents.

The sources that yielded the most quantity of water according to household heads' views are the fountains, while the sources with the safest water to drink, according to rural communities' views, are dams, followed by water tankers. In terms of distances to sources, the users of dams, water tankers, and fountains had to travel the longest distances to collect water. Reliable sources of water are fountains and rivers, as they are always available.

Rural communities are not happy with the water supply services they receive, as this is characterized by inconsistent supply. The management of rural water supply in VDM needs change and improvement as there was no active involvement of residents; in critical management decision-making on water provision, only VDM was the main actor. Vhembe District Municipality supplies both urban and rural households within the District. The main sources of water in the District, in order of frequency of use, are - piped water, wells and ground water through boreholes, rivers, springs, as well as tankers. There are 12 dams, three wells and about 887 boreholes that are functional. The main sources of water in VDM remain surface and ground water.

CHAPTER 5: EFFECTIVENESS OF THE CURRENT RURAL WATER SUPPLY SYSTEM TO MEETING POTABLE WATER SUPPLY NEEDS OF RURAL COMMUNITIES

5.1 Introduction

In this chapter, results on the effectiveness of the current water supply systems in VDM are presented. The chapter examines how effective the District is in meeting the potable water supply needs of the rural communities. It also presents possible measures that may be adopted to improve the effectiveness of the water supply system in the rural areas of VDM. The data was collected through focus-group discussions and questionnaires administered to individual household members, councillors, and municipal officials. The objective of gauging the water supply system's effectiveness was to look into - existing primary water sources, their reliability, issues on funding and payment systems, infrastructure and maintenance aspects of the water supply system, and the time it took for VDM to respond to water problems.

5.2 Results and Discussion

The section presents the results, analysis, and discussions as outlined below:

5.2.1 Water sources options

Based on Table 5.1, out of the 38 boreholes in the sampled communities of VDM, only 11 are functional (28.9%), and 27 are dysfunctional (71.1%). In summary, about 71.1% of boreholes are dysfunctional in the selected communities of VDM. This result poses a severe water supply challenge in the district, considering that the boreholes are the primary water sources. These water sources are inadequate compared to the existing population of 13 875 households. The results from Table 5.1 indicate that the potable water in VDM, is ineffectively delivered as the main source is dysfunctional.

In Collins Chabane Local Municipality (LIM345), 5 out of 14 (35.7%) boreholes were functional; this is a concern as there are more than 4946 households in the municipality. In Makhado Local Municipality, one community receives piped water from the dam, and 4 out of 19 (21.1%) boreholes were serving a population of 2948 households. Musina Local Mnicipality’s population was about 885 households, which were served by 1 out of 2 (50%) functioning boreholes. In Thulamela Local Municipality, piped water from the dam and rivers serviced communities and about 1 out of 3 (33.3%) functioning boreholes that supply water to a population of 5098

households. Also, Thulamela Local Municipality communities use fountains as the second primary water source after piped water from dams.

The results from Collins Chabane Local Municipality indicate that about 35.7% of boreholes are functional, while communities also get piped water from the dam. Furthermore, the water supply system is in a better state than in Thulamela Local Municipality and Makhado Local Municipality, where the water supply is ineffective, at 21.1% and 33.3%, respectively. Thulamela Local Municipality has a mixture of water supply options, although, most communities are located in the deep rural areas and rely on boreholes. The population growth and poor rainfall distribution are putting pressure on the water supply systems and on the available water resources. The majority of the boreholes are also unable to cope with the water demands, hence the water systems fail, or there are breakdowns. In some rural communities, especially Makhado Local Municipality, water tankers temporarily provide water supply relief to rural communities when such situations happen.

The non-functionality of boreholes and piped water systems was due to the aging infrastructure that hampered the VDM from delivering sufficient water supply to its communities. Some of these challenges, however, have taken many years to be addressed. The non-functionality of the boreholes in most villages exposes people to waterborne diseases, as they ended up collecting water from rivers and fountains, which are not protected from contamination.

Out of fifteen (15) water tankers that service households in the VDM, only two (2) were functional (about 13% functional) during data collection. When there is a breakdown of boreholes and during droughts, water tankers often cannot service the households. Often the water tankers breakdown as a result of overuse and their non-functionality rate is about 87%. The constant breakdown of the water tankers is an indication that their life span is reduced or affected from overuse. Some communities in Thulamela Local Municipality receive water from fountains, which is an indication that water supply is still a problem in some rural communities, thus, one can conclude that the water supply system in VDM is ineffective.

Table 5.1 The state of water sources availability in use as per villages in VDM

Municipality	*Villages*	*Number of boreholes*	*Functional*	*Not functional*	*Piped water received from tap water from dam*	*Water received from rivers*	*Water received from water tankers*	*Water received from fountains*
Thulamela	Mangaya	00	00	00	Yes	No	No	No
Thulamela	Tshandama	00	00	00	Yes	Yes	No	Yes
Thulamela	Madzivhanani Tshidongololwe	00	00	00	Yes			Yes
Thulamela	Tshixwadza	03	01	02				Yes
Musina	Mbodi	02	01	01				
Collins Chabane	Kurhuleni	04	01	03	Yes	No	No	No
Collins Chabane	Mahathlani	01	01	0	Yes			
Collins Chabane	Akani (Tiyani)	05	02	03	Yes			
Collins Chabane	Dovheni	01	01	0	Yes			
Collins Chabane	Khakhanwa	03	00	03	Yes			
Makhado	Madabani	03	00	03			Yes	
Makhado	Midoroni	12	03	09				
Makhado	Mashamba	03	01	02	Yes			
Makhado	Mavhunga	01	00	01				
	Total	**38**	**11**	**27**				

Source: (Survey, 2019)

In VDM, the primary sources of potable water were borehole mentioned by 45.3% of the respondents, followed by piped water mentioned by 35.3% of respondents. A few (4.0%) respondents indicated that their primary source was the rivers, and 5.4% of the respondents indicated that fountains were their primary source of water (Refer to Table 4.6, Chapter 4). Of the 38 total boreholes in the sampled communities, only 11 were functional, and 27 were broken down (Refer to Table 5.1 above). The results show that about 71.1% of boreholes (Table 5.1 above) are dysfunctional, which exposes people to diseases as they end up collecting water from unprotected sources, such as rivers and fountains.

Only 10.0% of respondents, on average, in VDM indicated that they relied on water tankers as a source of water supply as these are used in emergency cases, when the primary source is dysfunctional. This result shows that the water supply system in VDM was in a crisis and ineffective, especially in Makhado Local Municipality, where about 25% of the respondents relied on water tankers to get their daily water supply. Water tankers are normally used as temporal measures to address challenges in an emergency, hence, they are not supposed to be the primary source. During data collection, only two water tankers were functional out of the fifteen (15) water tankers available, highlighting the seriousness of the water problem in the district. The rest (13 water tankers) were dysfunctional.

This situation could also explain why a few water tankers were functional; this was due to overuse from the high demand for water. The fact that only a few water tankers are functional reduces the effectiveness of water tankers in serving the communities. Only two were functional out of the 15 water tankers; this means that about 87% of water tankers are dysfunctional, and it takes months and even years to fix them according to the municipal officials; an indicatation that the water supply is unreliable and ineffective. In other words, the non-operational tankers illustrate that water supply systems in VDM are unreliable since the District takes so long to repair them, including the tank system.

The use of rivers as mentioned by 14% of the respondents and the use of fountains mentioned by 19% of the respondents in Thulamela Local Municipality indicate that the VDM water supply system is ineffective as the water available is not protected from contaminants as households were relying on unprotected water sources (Refer to Figure 5.1). About 33% of the respondents in Thulamela Local Municipality mentioned rivers and fountains as their primary sources of water as they had no other option; this poses a health risk to communities, from waterborne diseases.

The results show that the VDM water system is ineffective and is failing communities by not providing them with clean potable water, timeously. Rivers and fountains are not as sustainable; their water quality is a problem as it exposes communities to waterborne diseases. Naiga *et al.,* (2015) concur that inadequate and non-availability of water sources forces communities to walk long distances to search for water, spending time which might be used for other productive activities. Ravet and Brailowski (2014) supported this view and confirmed that lack of enough water sources is why communities walk distances in search of water.

In Musina Local Municipality, 100% (Refer to Figure 5.1 below) of respondents sampled indicated that the primary source of water was boreholes; about 56% of the respondents in Makhado Local Municipality also indicated boreholes as their primary source of water; 49% of the respondents mentioned boreholes as their primary source in Collins Chabane Local Municipality. About 50% of the respondents in Collins Chabane Local Municipality indicated that they relied on piped water from the dams, while in Thulamela Local Municipality, 42% of the respondents mentioned piped water from the dams as their primary source; in Makhado Local Municipality, 19% of the respondents mentioned piped water from the dams as their primary source. Rivers and fountains were only used in Thulamela Local Municipality as the primary source according to 14% and 19% of respondents, respectively. In Makhado Local Municipality, 25% of the respondents indicated that water tankers were their primary source of potable water and that such were also used during emergencies when the primary sources were dysfunctional. Figure 5.1 shows that the water tankers were the primary sources of water for 9% of the respondents in Thulamela Local Municipality and about 1% of the respondents in Collins Chabane Local Municipality (Figure 5.1).

Most people in Makhado Local Municipality have boreholes, however, 25% of the respondents reported that piped water from the dams and water tankers are alternative sources of potable water. This result shows that water supply is inadequate, and this is a cause for serious concern. Makhado Local Municipality suffered from chronic water scarcity due to groundwater shortage and dried up of boreholes in some areas, especially the Sinthumule area and Madabani villages. There is a need, therefore, to look at other source options to resolve the water challenges in the Makhado Local Municipality.

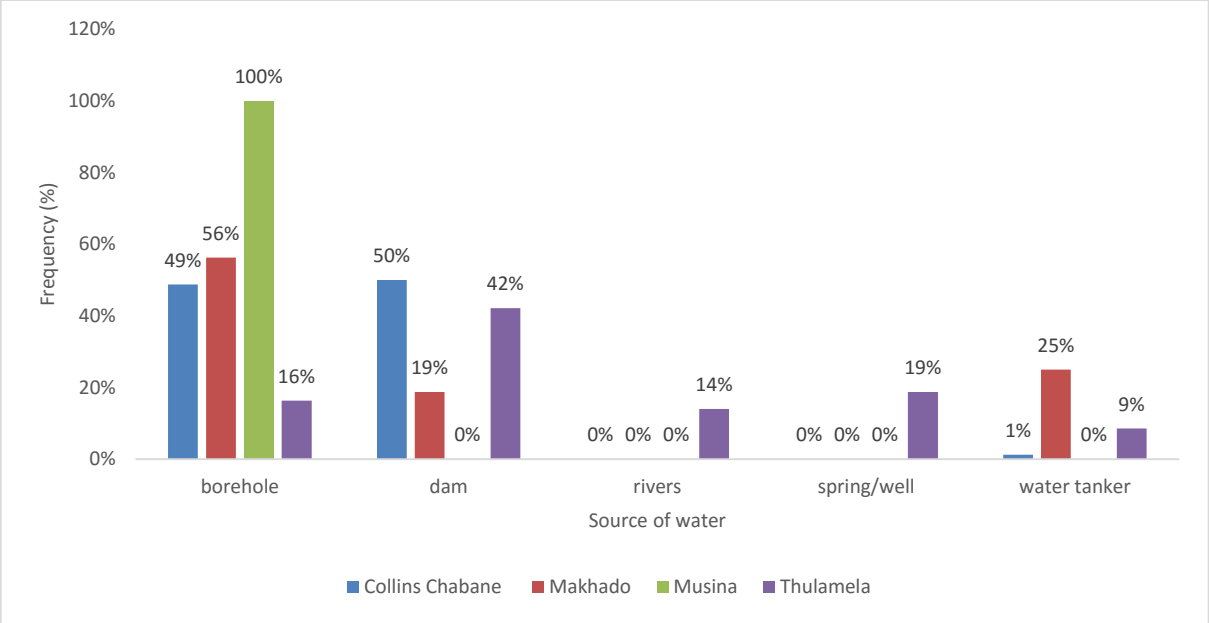


Figure: 5.1 Main water sources in different local municipalities of VDM

The breakdown of boreholes and stealing of transformers, as reported by respondents (councilors, households heads, and traditional leaders) were other problems and these harmed the effectiveness of water supply system; this is what one participant said:

"The main problems that hamper water access in our area is a breakdown of boreholes."

De Sounza and Costa Da Silva (2014) confirm that aging infrastructure was the main reason for the frequent breakdown of boreholes, and this hampers sufficient water supply to communities. The respondents' views indicate that the current systems' sources need to be strengthened to ensure consistency and effectiveness in delivering water to communities.

Most sources of water options in Thulamela's Local Municipality are – boreholes, piped water from dams, rivers, fountains/wells, and water tankers. There was a variety of water supply source options to ensure availability of water supply at all times, however, the management of these source options remains a significant challenge. This evidence is provided by the focus group of councilors, households heads, and traditional leaders; one said:

" as households, we are not actively involved in the water supply systems in the area, and even in terms of paying for water service."

Kumpel (2013)'s study revealed that households are willing to participate and pay if they are involved in the management of water project and are updated timeously about water service. Although The water supply needs in Collins Chabane's Local Municipality remain dire, however, if the two available options, the boreholes and piped water from dams, are well managed, this will ensure that every resident has water, even if a small amount at a time. The Musina Local Municipality relied entirely on boreholes as the only water supply (Refer to Figure 5.1 above). In the event of the borehole systems' failure, the residents of Musina Local Municipality were likely to go without water for days, which is unhygienic and would affect their lives. Fountains and rivers as the other sources were risky for communities as they end up contracting waterborne diseases due to these unprotected sources (WHO, 2014). Consequently, Tshikolomo *et al.* (2012) stress that using less-safe water sources was dangerous to human health, thus, they called for urgent intervention.

One respondent confirmed these views on the impact of system infrastructure and breakdown by saying:

"The boreholes in my area were installed many years ago when there were few households."

These views were reiterated by the focus-group discussants, who indicated that although there is an increased population, communities are still using the same sources installed many years ago, causing water demand to exceed the supply. The situation was aggravated by unplanned settlements by the communities who build homes all around, without consulting the municipality to plan for the services, including water that should be made available. According to the current population size, there was a need for more source options, if water supply effectiveness was to be achieved, according to the focus-group discussants. This point is articulated in the comment below:

"*The water infrastructure has been there for more than 20 years while the population increases every year".*

UNICEF and WHO (2012) made a similar point, that potable water demands will continue to increase due to population growth, global warming, and droughts. Respondents' views indicated that population numbers should be balanced with available water sources, if the systems' effectiveness is to be enhanced. Respondents from Makhado Local Municipality, and some

respondents from Thulamela and Collins Chabane local municipalities, articulated similar views. From the results, one can conclude that there is a need for more source options to be added, in proportion to the population size, if the water system's effectiveness is to be achieved.

The results demonstrate a severe problems with water supply delivery to the communities in the rural areas of the VDM. The state of affairs presents a serious concerns on the water supply and the reliability of the systems; these are rendering the water supply system in the District Municipality ineffective. Given this reality, there is a need for an urgent intervention to address the maintenance and addition of water tankers, if the water supply is to become reliable and achieve the national goals. The National Planning Commission (2011) envisages that all South Africans will have full, affordable, and reliable access to sufficient, safe water by 2030 in the National Development Plan.

5.2.2 Quantity of water received per day by households

According to 35.5% of the respondents, the households' size is four members per household, while 42.9% of the respondents indicated that the size was four and more per household (Refer to Table 4.5). The households in the sampled villages consisted of four and more members; this is the situation with the majority of the respondents (78.4%) (Refer to Figure 5.2). According to Free Basic Services Policy (FBSP) (2000), each household is entitled to a primary water supply of 25 liters of water, per person per day.

The majority of the respondents from Musina (91%) and Makhado (70%) Local Municipalities receive less than 100 liters per day (Refer to Figure 5.2). In line with the Free Basic Services Policy (FBSP) (2000) and the average household size of 4 members, 100 liters were not enough to meet households' daily potable water requirements. From the results, one can argue that the quantity of water received by the majority of households in VDM was inadequate according to constitutional requirement of 25 liters per person per day (FBSP, 2000) as most households have four or more household members, a fact that had been highlighted by 79% of the respondents.

In Thulamela, 48% of respondents indicated that they received less than 100 liters per day, while 33% of respondents indicated that households received between 100 liters and 250 liters per day (Refer to Figure 5.2). In Musina Local Municipality, around 91% of the respondents indicated that they received less than 100 liters per day. About 70% of respondents in Makhado Local

Municipality, in Collins Chabane Local Municipality, about 44%, replied that they received less than 100 liters of water per day, while 36% of households received between 100 liters and 250 liters per day.

In VDM, 55.3% of the respondents indicated that they received less than 100 liters per day, as most households have four or more members. The results paint a bleak picture which is contrary to the Free Basic Services Policy (FBSP) (2000); this poses a severe challenge to access to water. This challenge forces households to resort to using water from unprotected sources, like fountains and rivers, which in most cases causes waterborne diseases. Rodriques *et al.,* (2015) confirm that using water from unprotected sources is a health risk as consumers are likely to contract waterborne diseases. Given the results above, from one of the focus-group discussants (councilors, households heads, and traditional leaders), it was established that:

"Frequent breakdown of water supply systems caused less water received daily, ineffectiveness, and water supply failure in the VDM are reasons why we receive fewer quantities of water as required."

The focus group added that the quantity of water received was not enough; this VDM will need to address, since when the quantity of water is not enough, communities collect water from unprotected sources, which is risky to their health. Figure 5.2 below shows the statistics on the quantity of water received per local municipality.

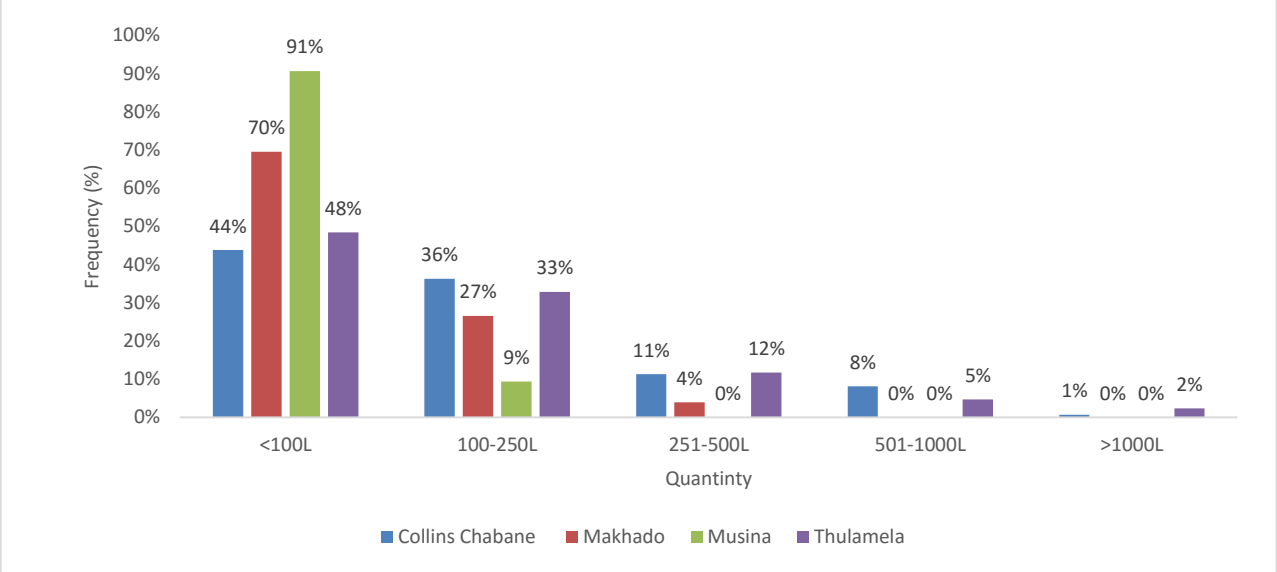


Figure 5.2 Quantity of water received in the VDM

5.2.3 Distance travelled to collect water from water points

Another crucial factor that the study sought to investigate was the water source's distance from the villagers. This objective sought to gain insight into the location of the water points in the context of older villagers who have no helpers to assist them by fetching water. About 59.2% of the respondents indicated that the location of the water sources was 200 meters away from where they stay, while, about 40.8% indicated that the source's location is within 200 meters from where they stay.

In Collins Chabane Local Municipality, 18.1% of the respondents indicated that the water sources are located more than 200 meters from their households, while 81.9% of respondents (Refer to Table 5.2) indicated that water sources are located within the yard which is 200 meters and less. In Makhado Local Municipality, 96.9% of the respondents indicated that their water sources are located more than 200 meters away from their households (yard), while in Musina Local Municipality, 43.8% of the respondents indicated that the location of the water source is inside the yard, less than 200 meters from the water point. Also, in Musina Local Municipality, 56.3% of the respondents indicated that the location of the water point is 200 meters away from their households. In Thulamela Local Municipality, about 73.4% of the respondents indicated that the water point's location was 200 meters away from their households. In total, about 26.6% of the respondents indicated that their water sources were 200 meters from their households.

In Collins Chabane Local Municipality, the majority (about 81.9% of the respondents) indicated that water sources were within 200 meters of their households, consistent with the standard requirements as enshrined in the Department of Water Affairs (2013) and FBSP (2000). The majority of Musina Local communities (more than 50%) travel more than 200 meters in search of water. In Makhado Local Municipality, most households, about 96.9% of the respondents indicated that they travel long distances in search of water due to water scarcity in the area. This result is inconsistent with the Water Service Act (1997), which indicates that the water source should be located within 200 meters from the yard; 3.1% of the respondents in Makhado Local Municipality indicated that they fetch water within less than 200 meters.

Residents in Thulamela and Musina Local Municipalities, travel long distances to search for water, while in Collins Chabane Local Municipality, 81.9% of the respondents indicated that water sources were within 200 meters from the yard. For Thulamela, Makhado, and Musina Local Municipalities, in terms of location of the water source, the distance traveled to collect water from primary sources is not compliant with the constitutional requirements of water being 200 meters

from the yard. This means that communities walk long distances to search for water, which indicates that the water supply system in VDM was still being ineffectively provided to the majority of the rural communities. This calls for the VDM to correct this anomaly.The district still lags in terms of location to water points, as per the legislative requirements. This was also observed by Naiga *et al.* (2015), who pointed out that there are rural residents who still walk more than 200 meters from their yards to fetch water. This shows that the VDM has a lot to do if it is to eradicate this challenge.

Table 5.2 Distance between household and water point in VDM

Variables			Local Municipalities				VDM
			Collins Chabane	Makhado	Musina	Thulamela	
Distance to water source	More than 200 metres	% within municipality	18.1%	96.9%	56.3%	73.4%	59.2%
	Less than 200 metres	% within municipality	81.9%	3.1%	43.8%	26.6%	40.8%
	Total	% within municipality	100.0	100.0	100.0	100.0	100.0

Source: (Survey, 2019)

5.2.4 Reliability of water sources in VDM in terms of daily water supply

Table 5.3 shows that about 82.6% of the respondents in VDM indicated that the water supply system was not reliable in terms of daily water supply as they do not receive consistent water supply, daily, from the primary source. An effective system is where water supply sources are consistently supplying water and with communities having more than one option available. Only 17.4% of the respondents in VDM indicated that the water supply system was reliable, therefore, not effectively delivered. From the researcher's observation, there are many reasons for the unreliability of the system in VDM, which include - lack of regular maintenance and aging infrastructure, which led to the continuous breakdown of the infrastructure. One other reason is that the population outnumbers the sources available as these were constructed 20 or 30 years ago.

The local municipality results were that, 100% of the respondents (household heads) in Collins Chabane Local Municipality were dissatisfied with the reliability of water supply system. About 96.1% of the respondents in Makhado Local Municipality and 68% from Thulamela Local Municipality indicated that they were also dissatisfied with the reliability of the water supply they received daily. In the Musina Local Municipality, 100% of the respondents indicated that the water supply system was reliable during the data collection visits.

The Musina Local Municipality water supply system's reliability was due to a competent maintenance officer who ensured regular maintenance of the system that consistently resulted in residents receiving water. The same view point emerged from the focus-group discussion (councilors, households heads, and traditional leaders) in Thulamela, Collins Chabane, and Makhado Local Municipalities, where one respondent said:

"*In our area, we have never seen maintenance officers maintaining the water infrastructure for years. Most of our water infrastructure was unreliable and dysfunctional for many years without being attended to".*

In Makhado, Thulamela and Collins Chabane Local Municipalities water was inconsistently supplied, due to the continuous breakdown of the system. Out of the four local municipalities in VDM, it was only Musina Local Municipality where the respondents indicated that water supply service was reliable (Refer to Table 5.3), implying that in Makhado, Thulamela, and Collins Chabane Local Municipalities the systems are ineffective and not reliable.

There is a need to intervene and address water supply challenges to make the system reliable in the VDM. Statistics South Africa (2013) revealed that 62% of households in rural areas continue to experience water disruptions showing the unreliability of the water system. Johannessen *et al.* (2014) also claim that dysfunctional operations and system failure is causing unreliability of water access.

The Statistics South Africa Community household survey (2016) reports that interruptions of water service for more than 48 hours for three months and interruptions for more than two days indicate that water supply is unreliable. Reports from Makhado Local Municipality, from 81.4% of respondents, Musina Local Municipality from 20, (6%) of respondents, and Thulamela Local Municipality from 90 (6%) of respondents note that water supply systems are not reliable, (Statistics South Community Households Survey, 2016). The report is consistent with the

findings of this study. In Musina Local Municipality, few respondents reported interruptions at 20.6%, which justifies the study results.

Table 5.3 Reliability of water supply system in VDM to meet daily water access

Variables			Local Municipalities				VDM
			Collins Chabane	Makhado	Musina	Thulamela	
Reliability of water system in VDM	Dissatisfaction	% within municipality	100.0	96.1	00.0	68.0	82.6
	Satisfaction	% within municipality	00.0	3.9	100.0	32.0	17.4
		% within municipality	100.0	100.0	100.0	100.0	100.0

Source, (Survey, 2019)

5.2.5 Participation of communities in water supply payment

More than 57.4% of the respondents in VDM (Table 5.4) indicated that they were not willing to pay for water services; one of the critical reasons stated was that they were not receiving water supply consistently in their areas. Only about 42.6% of the respondents in VDM indicated they were willing to pay for water services as long as they consistently received water and correct billing statements are provided monthly. A study carried out by Mavhungu (2011) concludes that failure by the municipality to recover costs from rural water users was one of the causes of most public water supply systems' failure. Jayaramu (2014) contends that communities are ready and willing to pay for water services when there was consistency in water supply in their area.

Responses from the interviews with municipal officials indicated that rural communities were not paying for water services they received, and that impacts the systems negatively as the provision was not sustainable. These results confirm that communities are not paying for water services that they receive. Municipal officials explained that there was no budget to fund fountains as the VDM managed very few of these. They complained that communities did not pay anything for

the water services they received from the local municipalities and this has had a detrimental effect on water supply.

The municipal officials added that there were communities who paid for the installation of standpipes inside their yards but did not continue to pay for water supply services. Statistics South Africa: Community household survey (2016) indicated that the majority of rural communities are poor and unable to pay for water access, hence, water infrastructure is limited. The results are inconsistent with those of Kativhu (2016) and Hoko *et al.* (2009), who established that rural communities in Zimbabwe, including poor households, are making financial contributions to water projects' success through their involvement in committees. The literature review indicates that rural communities can be made to pay for the sustainability of water projects, despite their social status. From the results, it can be argued that payment of water services received by communities is essential to sustain the service.

Adequate water supply to rural communities will remain a pipe dream if they do not contribute through payment for the provisioning process. There is no set formula on how water users may be involved in paying for water provision services, in order to make its availability sustainable, for the substantial number of households (57.4%) who can afford and are willing to pay for waters supply. Most households (42.6%) indicated that the water service payment would be possible, if the municipality could first provide consistent and reliable potable water services to them.

The culture of non-payment has been rife among the rural communities for a long time, and it needs to be corrected if a sustainable water supply is to be attained. Table 5.4 outlines views of the respondents on their willingness to pay for the potable water provision services. The non-payment by households, harm the District's ability to provide water services, and maintain the water resources, which would then positively affect the sustainability of the system. For the households to be willing and able to pay the district, VDM has the responsibility of providing regular water supply, which, currently, is not happening.

Table 5.4 Willingness to pay for water services from household heads

Willingness to pay	Percent
Yes	42.6
No	57.4
Total	100.0

Source, (Survey, 2019)

5.2.6 Response on the time taken to address water challenges

Questions on response time taken by officials to address water issues were raised and the councilors' responses are given in Figure 5.3; it is evident that there was a lackadaisical attitude towards reported cases of problematic water supply in the District. The view of the five councilors (80%) in Collins Chabane Local Municipality shows that VDM takes a long time to respond to water problems, and 100% of the four councillors for both Makhado and Thulamela Local Municplaiities indicated that there was inadequate response to maintenance issues when reported (Figure 5.3).

The response asserting quick response and maintenance results were similar, as indicated in Table 5.3. that those responsible for the maintenance did not respond in time to address problems reported. A total of 20% of the five councilors in Collins Chabane Local Municipalities and 100% of the councillors in Musina Local Municipality, however, were of the view that the maintenance people responded well to calls of faulty machinery or water-related problems (refer to Figure 5.3 below).

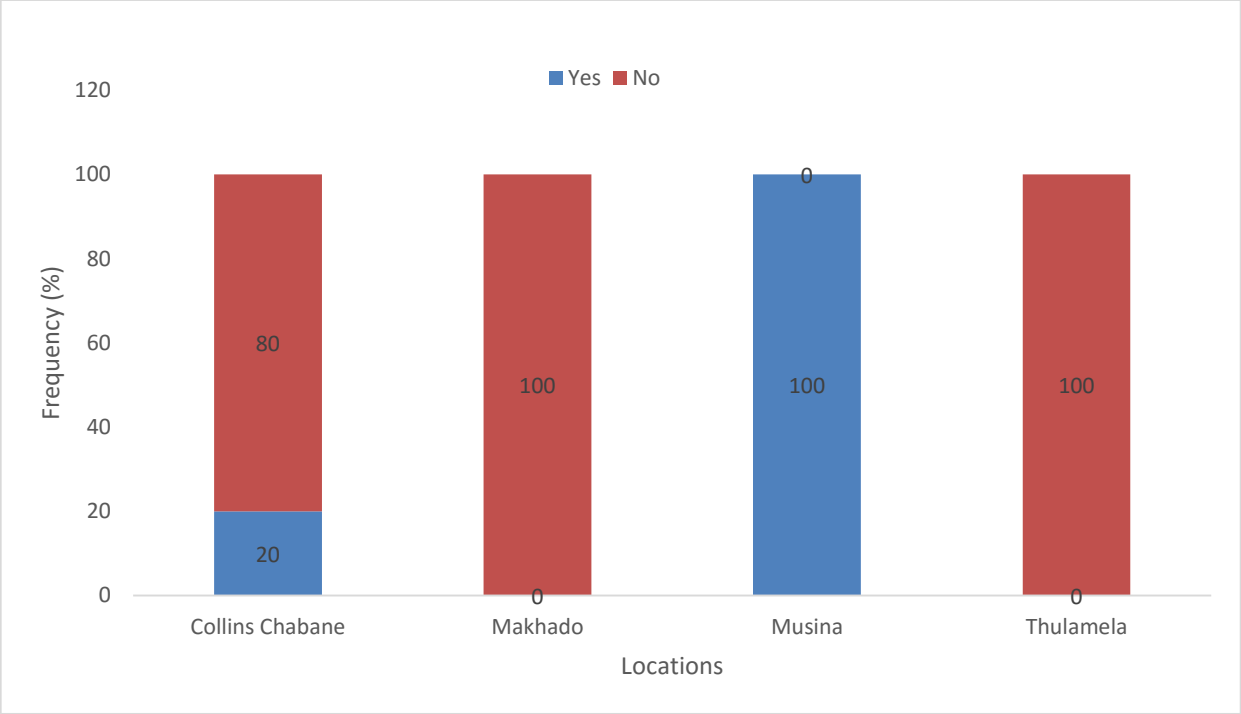


Figure 5.3 responses on time taken to resolve water challenges

The focus group discussants articulated the same view. One of the discussants (councilors, households heads, and traditional leaders) said the following words:

"There is no quick response from the District Municipality when water supply problems are reported."

From the researcher's observations, if there were competent technicians to operate the water systems, water-related problems could end. Strong leadership also pays off, as enough resources are used effectively. From the results, we can conclude that the water supply system in VDM was ineffective as communities are left stranded when their water-service problems take long to address. A discussant indicated that the other reasons why water supply challenges are not resolved urgently are due to the following:

"My view is that poor maintenance in my area is caused by a shortage of spare parts and maintenance officers."

The WHO (2013) argues that incompetent maintenance officers and poor leadership in the municipalities and among the communities make efficiency and effectiveness of water supply maintenance challenging to achieve. This is consistent with this research's results above, which

indicate that poor leadership and incompetent maintenance officers hamper the provision of water services as challenges take long to be resolved. A case in point was the Musina Local Municipality, which had a competent water service officer, hence, issues of maintenance were attended to quickly. The study by Obeta and Nkwankwo (2015) also confirmed the views of the respondents, that the lack of quick response was because of inadequate supply of equipment and spare parts for maintenance purposes, which had an impact on access.

5.2.7 Maintenance of water infrastructure for water supply system

The majority of the respondents (70%) in the VDM (Figure 5.4) indicated no maintenance of the water supply infrastructure. This hampered the effectiveness of the water supply system. The majority of the councillors' view were also upheld by the household heads and municipal officials from all four local municipalities, except Musina Local Municipality, where the maintenance officers were always available when called to address water challenges. The respondents were of the view that the technicians are reluctant to respond swiftly to the water supply-related concerns due to the old and dilapidated infrastructure. In some cases, a lack of spare parts contributed to the delay in resolving water supply challenges, as outlined by municipal officials. The challenges faced by rural municipalities include, the aging water infrastructure, which made it difficult to supply water consistently to the communities living in rural areas (Cothren, 2013).

Lack of skilled technicians, operators, and maintenance specialists remains another major challenge regarding the supply of potable water in rural areas, where groundwater was the primary source of water supply; the results of this study confirm the findings by Obeta and Nkwankwo (2015). WHO (2014) agrees with these findings that lack of officials' capacity to maintain the infrastructure remains the main problem affecting rural water supply. As a further justification of the study findings, Cobbing (2014) explained that most municipalities had an inadequate budget to cater for the operation and maintenance of water supply systems.

Municipal officials indicated that the maintenance of dams is done by the VDM, except one municipal official from VDM who pointed out that the responsibility of maintaining the rivers was with the Department of Water and Sanitation, however, according to most municipal officials, the maintenance of boreholes was done by the VDM. For the water tankers, the maintenance thereof was the responsibility of VDM, although there were stakeholders to maintain the machines, this was not done as much as it should, from the municipal officials' views. Those who were tasked to do so apparently tend to fold their arms and let the system collapse without any due care.

Inadequate budget and technicians to maintain the system and buy spare parts were cited as the main reasons for poor maintenance by municipal officials. This was confirmed by the respondents from Makhado, Collins Chabane, and Thulamela Local Municipalities; the household heads indicated that they had never seen maintenance officers in their area except for emergency cases. The results confirm Mema and Mothetha's (2013) observation that poor maintenance of borehole pumps, reservoirs, and pipes hamper water supply systems in the rural areas. In Mahathlani village, households did not want the VDM to assist them due to the demarcation of the municipality in their area as explained by municipal officials.

Tadesse *et al.* (2013) and Obeta and Nkwankwo (2015) viewed the lack of maintenance as the main reason that many rural water supply systems are dysfunctional. The consequence of this was severe unhygienic practices, which resulted in households suffering from deadly water-borne diseases. Figure 5.4 presents the status of the level of maintenance of water supply system infrastructure for each local municipality in the VDM, as observed by the councilors who are constitutionally responsible for the development agenda at the local government level. Figure 5.4 shows that only Musina Local Municipality's water supply system was being maintained. Collins Chabane Local Municipality had only 20% maintenance rate, while Thulamela and Makhado Local Municipalities water systems had zero maintenance. This implies that the majority of the households in the VDM were most of the time without water.

Figure 5.4 the Maintenance of infrastructure of water supply system

5.2.8 Level of satisfaction with the current water provision system

A Chi-square test was used to gauge the level of satisfaction by rural communities of the VDM water provision system. Cramer's V was used to analyze the nominal association and the strength of relationships. In terms of interpreting the Cramer's V results, 0.0 to 0.30 shows that there is no relationship to a weak relationship; 0.31 to 0.70 implies a moderate relationship, while 0.71 to 1.0 implies a healthy relationship.

Table 5.5 presents the households' level of satisfaction with - the quantity of water, distance travelled to collect water, the quantity from the alternative source, reliability of water supply system, and the community participation in the water supply system. All these variables greatly varied according to the local municipalities in the VDM with $P<0.001$. As seen in Table 5.5, there is a strong relationship between the local municipalities. The relationship between the quantity of water received, distance travelled to collect water, and quantity of water collected from alternative sources, the reliability of the water system, and community participation were all strongly significant based and did not depend on where the municipality is located; these results apply to all local municipalities of VDM.

In terms of the level of satisfaction with the quantity of water received from the primary sources, in Musina Local Municipality, all the respondents indicated that they were satisfied with the quantity and reliability of water received from the primary source because they receive water daily. The strength of the relationship between quantity and the location of the municipality was strongly significant with $P < 0.01$. In terms of distance travelled to collect water and quantity of water received from an alternative source in Musina Local Municipality, about 43.8% of the respondents and 0% of the respondents, respectively, indicated that they were not satisfied with the distance travelled to the water source, as well as with the water collected from the alternative water source.

There was a need for Musina Local Municipality to have different source options so that communities could access water within reasonable distances. In Thulamela Local Municipality, households were dissatisfied with the quantity of water received from the primary source, and distance travelled to collect water, according to 28.9%, and 26.6% of the respondents, respectively. About 32% of the respondents indicated that they were dissatisfied with the reliability of the water supply system in Thulamela Local Municipality.

About 53.6% and 74.2% of the respondents in Thulamela Local Municipality indicated that they were satisfied with the quantity of water received from an alternative source and community participation in the water supply system, respectively. There is a need for more participatory management and leadership of water sources in Thulamela Local Municipality, given that there are different possible mix of water source options, but the communities still experience water supply problems. If these source options can be used optimally and adequately managed, the Thulamela Local Municipality water supply system should be able to deliver water to its rural communities, effectively.

In Makhado Local Municipality (Table 5.5) indicated that none of the respondents were satisfied with the quantity of water received from the source; those satisfied with the distance travelled to collect water were about 3.1%; with the quantity received from the alternative source was 46.9%; reliability of the water supply systems was about 3.9% and with community participation were 47.7%. Water supply systems in Makhado Local Municipality were ineffective and needed urgent intervention as the majority of respondents were dissatisfied according to the results.

Communities travel long distances in search of water due to sources located more than 200 meters away from the yard. The water supply challenges in the Makhado Local Municipality emanates from the reality that the area is water-scarce and with limited water source options. In Collins Chabane Local Municipality, 81.9% of the households were satisfied with the distance travelled to collect water from alternative sources, while 67.5% were dissatisfied with the quantity of water received from the alternative water sources. Requirements that water sources should be located within 200 meters according to Water Service Act (1997) and Free Basic Water Supply Policy (2000) were obviously being disregarded. The relationship between variables and local municipalities is strongly significant with $P<0.001$, which will be outlined in Table 5.5. In terms of quantity of water received from the primary source, about 22.5% of the respondents indicated dissatisfaction; none and 49.4% of respondents were dissatisfied with the reliability of the water supply system and community participation in water services, respectively.

In Collins Chabane Local Municipality, the water supply system was ineffective and unreliable and yielded quantities of water which did not satisfy the communities. The households in Musina Local Municipality had 100% access to water, however, their main concern and dissatisfaction was the salt content in the water.

Table 5.5 Level of satisfaction with the current water provision system

Responses	Proportion of respondents who are satisfied, (count)% (n=448)				Cramer's V	Significance
	Collins Chabane (n=160)	Makhado (n=128)	Musina (n=32)	Thulamela (n=128)		
Satisfaction with quantity of water received	36(22.5)[a]	0(0.0)[b]	32(100.0)[c]	37(28.9)[a]	.571[2]	***
Satisfaction with the distance travelled to collect water	131(81.9)[a]	4(3.1)[b]	14(43.8)[c]	34(26.6)[c]	.664[2]	***
Satisfaction with quantity of water from alternative source	108(67.5)[a]	60(46.9)[b]	0(0.0)[c]	69(53.9)[a,b]	.339[2]	***
Reliability of water supply system	0(0.0)[a]	5(3.9)[a]	32(100.0)[b]	41(32.0)[c]	.702[3]	***
Effectiveness of community participation	79(49.4)[a]	61(47.7)[a]	25(78.1)[b]	95(74.2)[b]	.257[1]	***

Source: (Survey, 2019); *= P < 0.05, **= P < 0.01, ***= P < 0.001, n.s= not significant;

Proportions with similar superscripts are not statistically different from each other; [1]=no/weak relationship; [2]= moderate relationship; [3]= strong relationship; ( ) = count and outside bracket is the percentage.

5.3 Conclusion

The VDM has several sources of water available, however, most households have no consistent water supply, some did not have access mainly due to a dysfunctional water supply system and the distance to the water source. In some villages, households lacked potable water altogether, thus, they relied on untreated water from the rivers. In some villages, water sources were readily available, however, its management at the village level remained a significant challenge, since

the water lines could remain dysfunctional for a very long time without maintenance services attending to them.

Where the water source options were limited, the households were forced to survive on the water levels far below the stipulated government requirement, per household per day. Where water supply sources were dysfunctional, the households' water supply per day from alternative sources could be limited, costly, or not potable. The households' quantities of water received in the VDM were more often below the acceptable level stipulated in the Free Basic Water Supply Policy (2000) in VDM; more than 70% of households have four or more members, and most of them received less than 100 liters of water daily. The Free Basic Water Supply Policy (2000) requires that each household receives 25 liters per person per day, however, from the study's findings, a household with more than four and more members received less than 100 liters per day, which is below legislative policies. Some household members still walk long distances to collect water, which was against their constitutional right.

The unpredictable water interruptions, aging infrastructure, and inadequate maintenance of the water supply system made potable water unreliable except in the Musina Local Municipality. Some households indicated their desire to pay for water service received, if water was available all the time; the majority of them, however, were not paying. Many households in the rural VDM are indigent and rely on the government to pay for their water supply; the results also revealed that most households were not actively involved in the water supply process, either in the form of paying for the service or maintaining the system. However, They were rather, passive recipients of the water service, making it challenging for the VDM to sustain water services from the available potable water sources .

CHAPTER 6: WATER SOURCES, CHALLENGES AND COPING STRATEGIES USED IN VHEMBE DISTRICT MUNICIPALITY

6.1 Introduction

Chapter six presents the water challenges the households face in the VDM and the coping strategies they use to address these challenges.

6.2 Results and Discussion

6.3 The main water sources in VDM

The results reveal that most of the households from the VDM mainly rely on boreholes (45.3%), followed by (35.3 %) relying on piped water, and about 10% who rely on water tankers supplied by the local municipalities (Table 6.1). The remaining 5.4 % rely on water collected from spring or fountains, while 4% rely on rivers, despite the constitutional pronouncement that safeguards the water supply needs of the population. The Sustainable Development Goal (SDG) number 6 covers - universal access, improvement of water quality, efficient water use, supporting and strengthening the participation of local communities in improving water management - that needs to be achieved by 2030 to ensure availability and sustainable management of potable water and sanitation for all. This is consistent with findings by Doria (2006), who established that rural communities in sub-Saharan Africa rely on boreholes as the main source of water supply. This is a challenge, as people using water from unprotected sources like rivers and fountains, are likely to be exposed to waterborne diseases. Tshikolomo *et al.* (2012) also lamented that using unprotected sources exposes communities to unnecessary diseases that can be prevented if the household is provided with potable water.

Table 6.1: Distribution by main source of water according to household heads Source, (Survey, 2019)

Main Source of water	Percent
Borehole	45.3
Piped water	35.3
Rivers	4.0
Springs/fountains	5.4
Water tankers	10.0
Total	100.0

6.4 Challenges of rural water supply system in VDM

To get a better understanding of the VDMs water supply situation, a stock of available water sources was taken. It was found out that the District had 38 boreholes in the sampled villages. Out of 38 boreholes, only 11 were functional when data was being collected which constitute 28.9% functionality (Table 5.1). Compared to a total population sampled of 13 875 in the VDM, 11 boreholes cannot sustainably provide potable water to the population and this poses a significant challenge. It is no wonder that many households still depend on unsafe water sources like springs, fountains and rivers. Most of these boreholes are older than ten years and about 71.1% of them are dysfunctional.

Due to wear and tear and lack of maintenance, most of them have become dysfunctional. At the time of data collection, the VDM had only 15 water tanker trucks, and only two were functional. Such a situation forces households to rely on unsafe water sources. What can be concluded from the state of the primary water sources in the study area, was that they are not enough to safeguard water and sanitation needs; that there is a frequent breakdown of the system in the rural communities in VDM. This has a serious implication for the country's 2030 developmental aspirations and its commitments towards sustainable development goals relating to safe drinking and secure water.

From the households' point of view (Table 6.2) the most pertinent water supply challenges were related to the breakdown of the water supply infrastructure due to lack of maintenance and age. This concurs with Akhmouch (2012)’s findings that frequent breakdown, lack of maintenance, and old infrastructure affects water supply systems, negatively, in rural communities. The logical conclusion that the study arrived at was that water infrastructure in the area was old and dilapidated and was supposed to be replaced with new and modern infrastructure if the water authority was to deliver on its mandate, as stated in the Constitution of South African Republic (1996).

Table 6.2 Water service related challenges (Household Heads)

Challenges	Per cent
System breakdown, lack of maintenance, old infrastructure, vandalism and poor security	46
Lack of enough resources such as sources, Staff and funding	47
No communication operational hours and low pressure of water supply	7
Total	100.0

Source: (Survey, 2019)

Table 6.2 shows 47% of the respondents in VDM experience lack of enough funds and sources as the main problem to water supply to the households in rural areas. The system breakdown, lack of maintenance, old infrastructure, vandalism, and inadequate security on water sources were articulated by 46% of the respondents as the main challenges for rural water supply. Only 7% of the respondents indicated that there is no communication on operational hours and low pressure as the main problem.

The households in the focus group discussions (councillors, households, and traditional leaders) concurred with the view that the breakdown of water supply infrastructure, due to lack of maintenance was the significant challenges faced. This confirms Obeta and Nkwankwo (2015)'s study of the Sub - Saharan Africa, where poor maintenance of water supply infrastructure was identified as the main problem that could derail sustainable provision of potable water to rural communities.

Johannessen *et al.* (2014) equally confirmed that poorly designed and aging water infrastructure were the principal causes of the ineffectiveness of the water supply system in the rural areas of Africa and South Africa, in particular. An earlier study conducted in developing countries by Akhmouch (2012) revealed that adequate water supply among rural communities was hampered by the frequent breakdown of water infrastructure, lack of maintenance, old infrastructure, and vandalism. This was further exacerbated by a lack of funding for water supply programs.

The municipal officials responsible for water supply to the rural communities noted that out of the fifteen water tankers in the VDM, only two were operational due to the lack of maintenance. The

officials further lamented that the department responsible for maintenance was poorly funded, making it challenging to address the water supply system issues. A view of the municipal official responsible for water supply system was:

"Poor maintenance was caused by the lack of skilled technicians to manage the water supply infrastructure and inadequate funding."

Related to the above challenges was a lack of financial resources as well as a lack of skilled workforce to conduct routine maintenance, which exacerbated the maintenance of the water supply infrastructure. The mismatch between the demand for water and the old infrastructure's ability to provide water to the growing population, strained the ability to supply potable water in the rural areas.

The municipal officials also lamented that a shortage of funds to purchase fuel and spare parts were crippling their capacity to deliver water and sanitation services to the communities. The officials stated that due to an extensive supply chain process, it takes too long to buy spare parts to replace the vandalized infrastructure. As Obeta and Nkwankwo (2015) and Tadesse *et al.* (2013) noted in a similar situation, inadequate or lack of infrastructure maintenance remained one of the main problems that contribute to water supply systems' failure.

The consequence of such failure causes severe unhygienic practice, which results in the suffering of communities from waterborne diseases. The poor performance caused by the unavailability of technicians to maintain water infrastructure was another problem. Lack of funds in the VDM results in long maintenance delays of the water supply infrastructure. At the time of the study, some of the infrastructure had been lying idle for many years due to technicians' unavailability. This challenge was identified by the study of Cobbing (2014), who indicated that without the funding to operate and maintain boreholes, the water supply systems collapse and are unable to consistently supply water to communities, especially in the rural areas.

The lack of skilled technicians was raised as a contributory factor by ECA (2013), hence, the concern for adequate water supply systems needs to be addressed. Cothren (2013) claims that the shortage of technicians to maintain water supply systems as a leading problem, which requires an urgent response by the relevant authorities. A municipal official also firmly held this view during data collection:

"There have been inadequate technicians to maintain water supply infrastructure, and the problem was exacerbated by non-replacement of retired artisans" (views of municipal official)."

The municipal official further indicated that some related constraints included budget constraints to fund the maintenance of the water supply system, aging staff members who were not replaced when they retired, and the shortage of transport to take officials to the areas where water supply challenges occurred. Lockwood and Smits (2011) and Tremolet (2013) assert that, in many successful rural water supply systems, globally andin Africa, water committees at the village level were the ones that managed, operated, maintained, and ensured that costs of the systems' usage were duly paid. Such an argument places the need for communities' participation at the center of the water supply system so that they can manage the usage and maintenance of the infrastructure for consistent water supply. Photo 6.1 presents a picture of a borehole that was sunk more than twenty years ago. This is one of the many boreholes that broke down and had never been repaired.

Photo 6.1: Borehole in Madabani (broke down more than twenty years ago and since then the community relys on water from municipal water tankers) Source: (Survey, 2019)

A quick response to the water supply challenge and timeous maintenance of the water infrastructure are critical for sustainable water supply. It is only in Musina Local Municipality where all councillors (Figure 6.1) indicated that it took usually a week for water challenges to be attended to. Three out of the five councillors in Collins Chabane Local Municipality indicated that it took three months for water supply challenges to be attended to by VDM (Refer to Figure 6.1). With Makhado Local Municipality, about three out of four councilors indicated that it took more than a year for the water supply challenges to be attended to. In Thulamela Local Municipality, two out of four councilors indicated that it took a year for water problems to be addressed. This might be one reason why some communities resort to rivers, fountains, or springs as their source of water supply (Figure 6.1).

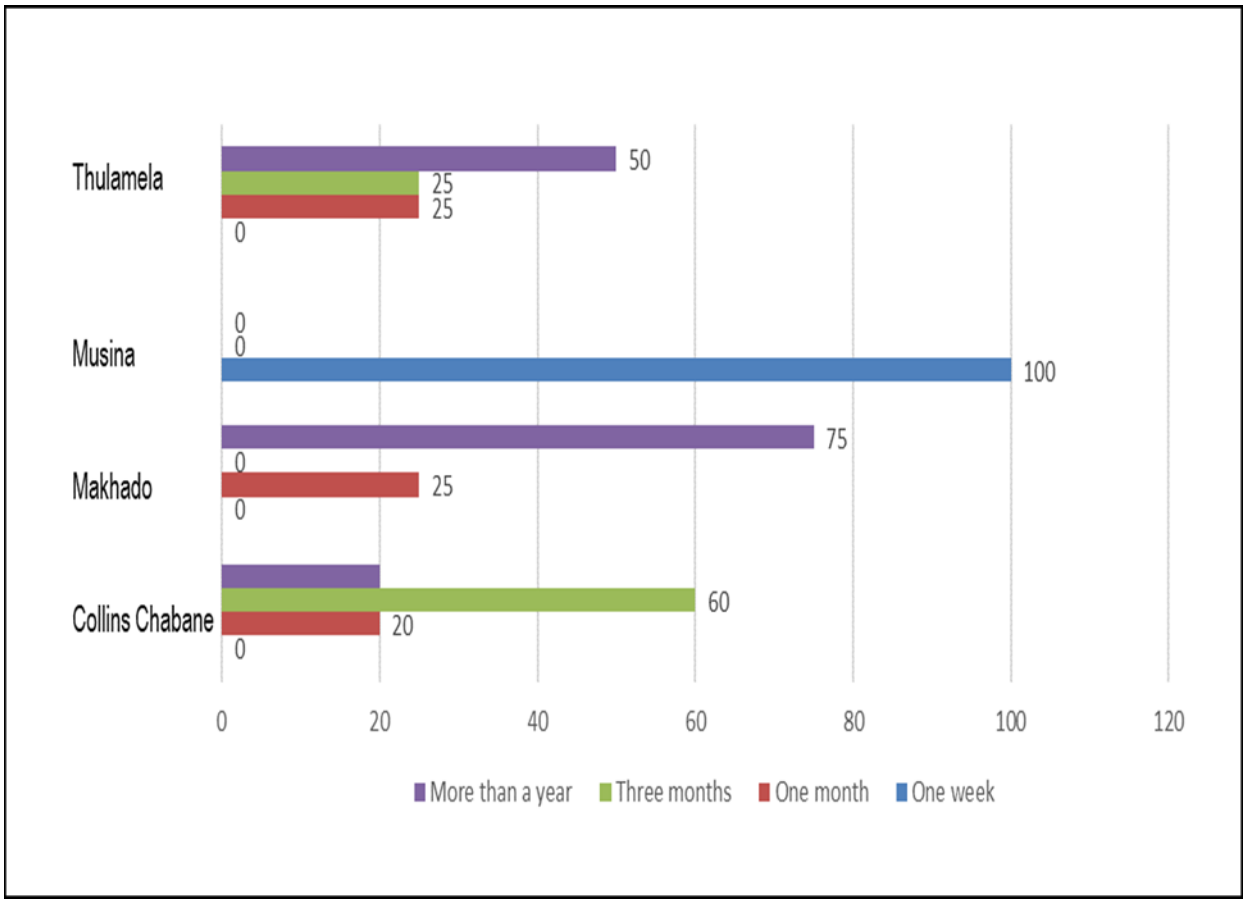


Figure 6.1: The length of time to solve water supply problems

The facts on the ground are contrary to the Department of Water Affairs' (2013) guidelines, stating that:

"Water interruptions should be less than 48 hours at any given time and less than 15 days in a year cumulatively".

This has also been established by Cothren (2013) and Johannessen *et al.* (2014) who maintain that aging infrastructure and lack of spare parts affected the normal functioning of water supply systems, which resulted in many systems breaking down. The focus-group discussants (councilors, households heads, and traditional leaders) also raised the issue of the link between the local municipalities and the VDM to address the water service problems in these comments:

"*There is no link between the local municipality and the district concerning water supply, as water is the district municipality."*

"Councillors in the local municipality are just conveyor belt of the challenges encountered by communities." .

The other reason why water supply challenges are to be addressed was that the local elected councilor were spectators in the ward; local councilors do not have a say on the water supply system as this was the VDM's responsibility. The councilors' role in the water provision system in the district municipality appears not to be clearly defined. The situation is further compromised by the lack of a clear link between the district and the local municipality's water and sanitation operations offices. In the satellite offices, no official could, for example, make decisions to addressed challenges when they are rised.

The challenges hampering communities constitutional rights are many and require a mix of local and national level solutions. This calls for efforts to institutionalize local level participation in the water supply services and capacitate national level structures, including villages, to respond to the challenges quickly. The municipality alone cannot provide sustainable water supply services in an efficient, equitable, and accessible manner (in terms of distance, time, and affordability) to all its rural communities without local communities' involvement.

There is a need to establish villages and ward committees to assist in managing and resolving some of the challenges related to water, that is not politically aligned. The situation is not just endemic to VDM's rural areas but is typical of rural areas in Sub-Saharan Africa. The challenges require serious attention in the face of climate change that is affecting the availability of water,

growing population, and financial constraints affecting local authorities' efforts to deliver services to rural communities. The solutions could be lying in communities' active participation in decision-making on water supply systems in their area, where they should also contribute financially towards efforts for sustainable and efficient water supply systems.

When water challenges are only addressed after an extended period, the community members have no option but to resort to unprotected sources, which may negatively affect their health. Sandeva *et al.* (2015) cited the causes of delay in addressing these problems as poor leadership and lack of institutional capacity to deal with them. On the other hand, Jayaramu (2014) asserts that the regular update on water services and timely and accurate responses to inquiries leave rural people satisfied, despite the challenges.

6.5 Coping strategies used when there are water supply problems

In the face of dysfunctional water supply infrastructure, communities resort to buying water from water vendors (73.7%). Some community members resort to relying on rivers (8.5%) as indicated earlier and fountains (6.9%) and water tankers (3.8%) (Refer to Table 6.3) as alternative water sources. Some of the residents have to walk long distances to collect water, mainly, from fountains.

This was also identified by Cook (2016), Ahmed *et al.* (2015) and Akali *et al.* (2015), Tshikolomo *et al.* (2012) and Adeoye *et al.* (2013) when they said that some of the failure of the public water supply system force residents in rural areas to come up with the coping strategies that include buying from vendors, drilling own boreholes and collecting water from rivers and fountains while wealthy residents sink boreholes in their own households and compounds. Some residents resort to storing water in tanks and containers to cope with water challenges. In Tshandama village, Thulamela Local Municipality, communities (Figure 6.4) agreed and contributed to connect water from fountains and rivers on their own, to cope with water supply shortages. Table 6.3 summarises the statistical information about alternative sources when the primary source is not available.

Table 6.3 Alternative water source in VDM

Alternative source	Percent
buying	73.7
water tanker	3.8
fountain	6.9
river	8.5
Other (specify)	7.1
Total	100.0

Source: (Survey, 2019)

The community members who resorted to rivers were 8.5% of the sampled households with 6.9% depending on fountains (Table 6.3). An example is Tshandama village fountain (Refer to Photo 6.2), on which the community relied as an alternative water supply in times of challenges. As a result of water shortage, the Tshandama community contributed funds to buy pipes and used them to connect to a fountain (Refer to Photo 6.2) and Mutale River to address their water shortage needs.

Photo 6.2: Pipes connecting the fountain at Tshandama village to Mutale river as a community copping strategy. Source: (Survey, 2019)

6.6 Conclusion

Chapter six looked at the sources, challenges, and the coping strategies the households use to address the challenges. The results revealed that residents of the Vhembe District Municipality rely on diverse water sources, namely, boreholes, piped water from dams, water tankers, rivers, springs, and fountains. The community members rely on water from rivers, fountains and springs, when the municipality-managed water sources - boreholes, piped water from dams or water tankers - become unreliable or dysfunctional.

The results revealed some severe challenges to the potable water supply system, which include a lack of funds to hire technicians, water systems' breakdown, lack of maintenance, old infrastructure, vandalism, and inadequate security. The infrastructure for water supply remains the major challenge faced; this hinders the community members from enjoying their constitutional rights of access to reliable and safe potable water, all the time.

In the face of water supply-related challenges, households who can afford, buy water from those who have their own boreholes. Those who are unable to, turn to the rivers, springs, and fountains which are very unreliable sources of water. It was established that participation or involving community members in the management and leadership of the water supply process would go a long way to reduce water supply challenges that households are currently facing.

CHAPTER 7: SYNTHESIS OF THE STUDY AND THE SUGGESTED STRATEGY FOR EFFECTIVE POTABLE RURAL WATER SUPPLY SYSTEM

7.1 Introduction

In this chapter, the main findings, conclusions, and recommendations from each objective are presented. A more effective strategy that can be used to improve the water supply system in the rural areas of the Vhembe District Municipality and beyond is proposed. The areas for policy consideration and further investigation are also suggested in this chapter. The four specific objectives addressed in this study were to: a) determine the existing potable water supply system sources in rural communities of the Vhembe District Municipality (VDM); b) examine the effectiveness of the current rural water supply system to meet the potable water supply needs of rural communities in VDM; c) identify challenges and coping strategies used to meet potable water supply in VDM; and d) propose a more effective intervention strategy for effective potable water supply systems to rural communities in VDM.

7.2 Key findings

7.2.1 Existing sources of the water supply system to rural community members

The study results reveal that the existing main sources of potable water in the rural areas of the Vhembe District Municipality as boreholes, piped water from dams, and water tankers as an alternative option when others are not available. The boreholes are the main source of water, accounting for 45.3% of the water supplied to the rural communities. This is followed by piped water from dams at 35.3% and water tankers at 10%. The water tankers are provided by the Municipality when piped water or boreholes are not functional. Other alternative sources of water in rural households include rivers, wells, springs, and fountains that are not safe for drinking.

Concerning local municipalities in the VDM, the study found that 50% of households at Collins Chabane Local Municipality relied on piped water, while 48.8% relied on boreholes in Makhado Local Municipality, 56.3% get potable water from boreholes. Makhado Local Municipality is hard hit by water scarcity as 25% of respondents indicated they relied on water tankers as their primary source. All respondents in Musina Local Municipality indicated they got their water from boreholes. Musina Local Municipality has one source option, if this source was to break down, it would leave the communities stranded. In Thulamela Local Municipality, 42.2% get their water

from the piped source from dams, 16.4 % from boreholes,18.8 % from fountains and 14%, and 8.6% from other rivers and water tankers respectively.

The Musina Local Municipality is a farming area and relies solely on the borehole water source option. This is somewhat problematic because if their breakdown, the households that are entirely reliant on the sole water system source would be negatively affected. Makhado Local Municipality is a water-scarce local municipality that has chronic water shortage and supply challenges due to limited groundwater. When the borehole breaks down, the households are at the mercy of the tankers that are becoming more and more unreliable. Often, people who can afford depend on private tankers to provide water at a cost. The situation leaves the poor and indigent people without water for days.

In terms of the frequency of access to water, in line with Water Affairs Strategic Framework (2013), the result revealed that 53.6% of the respondents had access to potable water supply for at least once a week, while only 30.1% get water every day. This clearly shows that about 70% of households do not receive water supply daily as per the requirements of the Water Affairs Strategic Framework (2013) and FBSP (2000). The results reveal that the quantity of water received was less than 100 liters per household.

The results revealed that the Collins Chabane Local Municipality and Musina Local Municipality households were satisfied with the distance travelled to the water source, the quantity of water received, and the reliability of the water supply systems. The households travel less than 200 meters to the main water source, however, households in Makhado Local Municipality and Thulamela Local Municipality indicated that they were not satisfied with the distance travelled to the main water sources, which was more than 220 meters. This was inconsistent with the Water Service Act (1997), which indicates that the water source should be located within 200 meters from the yard.

7.2.2 Effectiveness of the current rural water supply system in meeting potable water supply needs for rural communities in VDM

The power to provide water to the population, the water-related infrastructure, and the systems used is vested inn the district municipality as mandated by the Constitution of South Africa (Act 108 of 1996). This implies that the district municipality is responsible for providing safe water, maintaining the water supply system, repairing and replacing broken water-related infrastructure.

The local municipality is the government's sphere that is closest to the people, however, none of the water-related functions were delegated to it. Such arrangements lengthen the turnaround period for the district municipalities when there is a problem with the water supply system. It was no wonder that the results revealed a lack of effectiveness in the supply of required quantities of potable water to the residents of the four local municipalities, in the Vhembe District Municipality.

The primary source of water in the VDM is a borehole, however, the results revealed that, out of 38 boreholes in the VDM, only 11 were functional which constitute 28.9% functionality of the boreholes. The findings indicate that about 71.1% of boreholes in VDM are dysfunctional in the sampled households; this warrants serious attention. In addition to this, is the reality that those who depend on piped water often go for days with dry taps. Sometimes the municipality uses water takers to supply water in the event of an emergency, which in most cases, were not reliable because out of the 15 water tankers in the VDM, only two are functional.

With the increasing population, the available water source remains inadequate, rendering the water supply system in the VDM ineffective. The results revealed that communities in all four local municipalities received less than 100 liters per day, less than the required quantities. This was indicated by about 91% of Musina Local Municipality, 70% in Makhado Local Municipality, 48% in Thulamela Local Municipality, and about 44% in Collins Chabane Local Municipality. Added to this is the distance to the water sources. The Makhado and Thulamela Local Municipalities' households indicated that they were not satisfied with the distance of more than 220 meters to the water source.

In all four municipalities, the results revealed that the water supply system was not fully functional. This was due to poor maintenance of the water-related infrastructures, no security at the pump stations, and financial constraints contributing to the inadequate and ineffective water supply system in the VDM. The VDM administrator further strengthened the ineffectiveness narrative when they raised issues of non-availability of spare parts as the leading cause in case of broken down boreholes and financial constraints. It was further reported that officials and operators' lack of capacity often caused the potable water supply system to be ineffective.

The results revealed that the majority of the households (57.4%) were willing to pay for water supply service. This low percentage is due to a lack of consistent water supply; it can then be assumed that payment from communities might enhance water provision in their area. Respondents complained that the VDM no longer responds to water supply service-related concerns, however, all respondents from Musina Local Municipality upheld that the maintenance

officers responded well to water supply challenges. It might help to conduct an in-depth study to establish what Musina Local Municipality is doing that other local municipalities are not doing.

The VDM has a variety of existing water sources, however, all four local municipalities expressed dissatisfaction with the water supply system. Most respondents believed that the water system is not effective due to maintenance issues of the water-related infrastructure, dysfunctional boreholes, and aging water infrastructure inherited from the apartheid regime by the District. The later has been singly identified as the key contributing factor to the ineffectiveness of the potable water supply system in the District.

7.2.3 Challenges and coping strategies used to meet potable water supply in VDM

(a) Challenges of potable water supply in VDM

This study identified the following challenge concerning water supply in the district - dysfunctional boreholes. This shows that the VDM has a severe water supply problem considering that the boreholes are the primary water sources. This study found that the breakdown of the water supply system in the VDM is the main problem that hampers the water supply. Also, the aging infrastructure was problematic in providing water to the VDM's rural communities.

This has been the case in some areas where the manifestation of aged pipes, lack of spares, and proper maintenance and services were apparent during fieldwork. Also, the lack of skilled technicians in the VDM causes stress on the water supply system. This is confirmed by Cothren (2013), who indicated that the shortage of technicians at the district level is the leading problem for the potable water supply and that needs urgent attention.

(b) Coping and adaptation strategies to meet potable water supply in VDM

As a coping strategy, communities buy water from water vendors. This is problematic for poor households who cannot afford to buy water, and hence they resort to using water from unprotected sources. There are some rural households that contribute to buy diesel for the pump in case the diesel supply by VDM is finished before the end of the month. There are also communities that contributed to the purchase of pipeline to connect water from the river to cope with water shortages. Most households use water from any source without treating it. Some of the households drill own boreholes and even buy water tanks to store water for future use in times of demands. In addition, households collect water from unprotected sources which are

often far from where they reside. As a coping strategy, the district has provided 15 water tankers to supply water in areas where there is a need for water. The District has also implemented water shedding rotationally in villages to assist with the water supply.

7.3 Proposed Intervention strategy to address water challenges in VDM:

Based on the findings, the following intervention strategy is proposed to improve the water supply system in VDM. The following five pillars constitute the proposed strategy as a measure to improve the water supply system challenge in the Vhembe District Munincipality and beyond.

i) Establishment of a community water management structure for its water supply system

There is a need for VDM to establish a local water supply system management committee tasked to manage the water supply system from the village, ward, and local municipality levels up to VDM. This is necessary to deepen communities' involvement in the management of water supply systems in their area, and this will assist in resolving many of the water supply gaps in VDM, and in turning around the response rate by VDM. A by-law needs to be redesigned to include water committees and their functions in villages in the Local Government: Municipal Systems Act 32 of 2000 and Water Service Act 108 of 1997. There is a need to link the local municipality and VDM in terms of water supply-related activities for synergy in resolving water challenges. The structure should assist in reducing Illegal connections and unplanned settlement. The illegal connection should be discouraged at all costs by VDM, traditional leaders, and rural communities. A toll - free number should be established to report water-related challenges so that they can be speedily resolved.

ii) Introduce a community and municipality negotiated service payment system

The result revealed that a large number of households were ready to pay for water service if they would be guaranteed consistent water supply. Anchored on this result, the VDM should negotiate a position with the grassroots communities and together come up with a water payment structure that is acceptable to both sides in order to improve the water supply. The VDM should ensure that there are active community participation and involvement of the grassroots community in terms of payment of water service and maintenances of the system.

This will create a sense of ownership of the water supply system. Additionally, there should be the training of the local management committee on minor maintenances, a collection of user-

fees at the village level; and labour to assist in the effective functioning of the systems irrespective of their social status, by VDM. Furthermore, communities also need to be involved in monitoring and reporting on the water systems on a monthly basis. An option which may be pursued by both the VDM and the grassroots communities include seeking donor funding for the development of the water sources. This would go a long way in increasing the budget to assist in improving the water supply and its management. The availability of funds would help the municipality to regularly maintain boreholes, water tankers, and piped-water systems.

iii) Increase investment for more water supply options

Additional water source options are necessary where few sources are available, like in Musina and Makhado Local Municipalities. In Musina Local Municipality, and in collaboration with the community members, alternative sources should be identified and established, and the households encouraged to look after such water infrastructure. There is a need to provide additional water source options where there are few or where source options are dysfunctional. Such water options could include piped water, boreholes, and water tankers for an emergency or in case of breakages. This will ensure that the distance to a water source is reduced and also quantities of water received will be improved. The use of unprotected sources will no longer be necessary if there is the consistency of water supply, hence, discouraging the use of unprotected and unsafe water sources.

iv) Establish partnership with stakeholders to find solutions to water service delivery challenges

In order to ensure a smooth and sustainable water supply system, there is a need to introduce a decentralized water supply system management. This would be done through forging or introducing partnerships between the local community members, local municipality, and the district municipality in the management of the grassroots communities' water supply system.

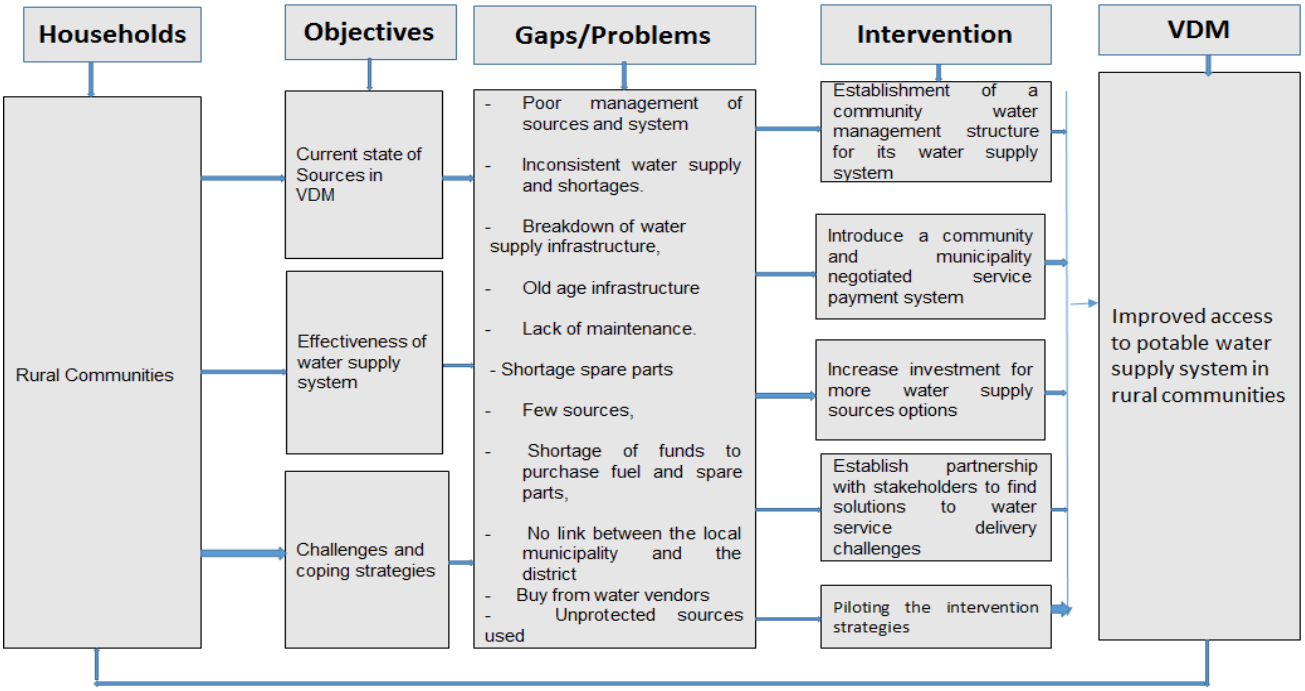
Partnerships between the district municipality with institutions of higher learning, like the universities and Technical and Vocational Education and Training (TVET) colleges need to be established to assist in establishing micro-treatment plants for the water from the fountains and rivers in order to make them safe for use by the communities. In addition, involving the higher learning institutions would help in providing the needed capacity for the local communities and any newly-formed water supply management teams or committees to effectively deliver on the water project and also assist in the placement of their students for experiential learning.

Furthermore, the universities would continuously engage the VDM in research on diverse water-related issues with a view to improving the rural communities' lifestyles as well as exploring the placement of students for internships in water-related activities. Such an endeavor would help speed up the resolution of water-related challenges. Community service for graduates may need to be introduced by government in institution of higher learning to assist communities in the area of their expertise which would include water-related experts. A law will need to be passed by the Department of Higher Education and Training to address such.

v) Piloting the intervention strategies

With the municipality's approval, the proposed intervention strategy will be pilot-tested in selected villages to gauge its effectiveness in addressing the rural water supply challenge before it is introduced on the broader Vhembe District Municipality. Pilot testing will be done in order to establish areas for adjustment before it is implemented in VDM. When the District Municipality has adopted the pilot tested strategy, implementation would be initiated to address the water supply challenges. The proposed summary of the intervention strategy is indicated below.

Table 7.1 Proposed Interverntion Strategy for Effective Potable Water Supply system in VDM



Source: (Survey, 2019) Proposed Intervention Strategy

7.4 Conclusion

The main sources of water supply in the Vhembe District Municipality in terms of numbers are the boreholes, followed by piped water from the dams. The number of water sources are not proportionate to the population increase. Most of the boreholes used are more than twenty years old. This has largely contributed to their frequent breakdown, rendering communities waterless in the process. The piped water and borehole maintenance are not regularly done, which causes frequent breakdown of water infrastructure and which affects the supply. The state of water supply in VDM is not in a good shape and there is a need for intervention to speed up water service delivery.

This means that if the main source of the portable water supply is not reliable, rural communities here suffer the consequences of spending weeks if not months with inadequate potable water supply sources. Consequently, rural communities become vulnerable to exploitation by the water vendors. Hardest hit are the poor households as they end up collecting water from unprotected sources. This is more prevalent in the Makhado Local Municipality, and this needs urgent

intervention. As Makhado Local Municipality is a drought-prone area, the situation can be resolved by the active involvement of the VDM and communities through the provision of more water tankers and the construction of additional dams.

The Thulamela Local Municipality is a different proposition as it is endowed with rivers and fountains. What is needed in this local municipality is for the authorities to protect these sources for clean and safe domestic water supply and also provide leadership in this area. That is, the available fountains should be formalised for the rural communities to use clean and safe water. This could be enhanced by the establishment of water treatment plants. Most water tankers are dysfunctional and this is a serious concern as there are communities without functional water sources who rely on them. Musina Local Municipality's one source option may not be enough, hence, it requires additional sources. A dam may need to be constructed on the Limpopo river. Basically, management of sources by villages themselves together with VDM may be the needed option for effectiveness of water supply system in VDM, including Collins Chabane Local Municipality.

There is a need for the VDM to have a specific budget for the construction of new water sources, maintenance, and the purchase of spare parts and the hiring of additional staff. Unplanned settlements should be formalised in order to have the proper figures in terms of households that require portable water supply in the district. Due to breakdown and water system sources challenges VDM is experiencing, water supply effectiveness, therefore, is still a dream in the majority of rural communities.

Rural communities are bad clients who do not want to pay for the water services they receive from their district municipality. This phenomenon has contributed to the ineffective supply of portable water to rural communities as the VDM struggles to mobilise funds to provide effective portable water services. The most efficient way to address this anomaly is for the VDM to take action against those who default on their water bills payments. For fear of arrest, the said households would contribute towards the payment of their water bills, either in cash or kind. Also, the VDM should establish and help train communities and water committees on the proper management of their water supply system.

Given the above, one would conclude that the mixed-method approach would help in bringing balance to the information received from the participants. This made this study easy to do. In short, the use of the mixed methods approach led to a nuanced understanding of the water supply challenges, and the strategies that might be used to mitigate the water supply challenges

in the VDM. Seasonal determinants on the water supply system were not examined by this study. This study was limited to the VDM's local municipalities, thus, its findings may not be generalised to urban settings as the research was confined to the VDM's rural communities.

7.5 Contribution Made by the Research

7.5.1 Contribution to Scholarship of Practice

Given the empirical main findings, conclusions, and literature review, this study recommends that the water supply sources' management structure involves people from the village, ward, and local up to the district municipality. The people involved should be well empowered to deal with the water challenges in the VDM. Councillors are responsible for enforcing community participation at the local level need to assist in ensuring the effective functioning of the committees at the village level. The committees should ensure that minor maintenance and repairs are done at the village level. Multiple water source options should be availed to rural communities.

These could include the micro-treatment plants and boreholes for homesteads that should be managed by the proposed committees. Communal boreholes should be made available, and this would reduce the frequent breakdown of the water system. Identified potable water sources in the area, such as fountains and springs, need to be protected and formalized to increase source options. This should be by way of proper fencing so that animals do not pollute water.

The District should prioritize the regular maintenance and servicing of boreholes; such programs should include community participation in order to create a sense of ownership. A partnership with academic institutions should be done to assist in maintaining and purifying water, and capacity-building of community members on the water project. This study recommends that resources, including source options, be increased and made available to all communities and buy-ins from communities in the form of payments, should be encouraged by the VDM. Traditional leaders and councillors should develop a mechanism that would enable them to report any breakdown in the water service delivery on time. The management structure from the local level needs to be established in order to deal with management, payments, and maintenance issues.

Members of the community should be the ones to secure the pump stations so that every member of the community polices the area. Unplanned development and illegal connections

should be discouraged at all costs by the community, traditional leaders, and the District. Water leakage should be reported on time, and the District should have a dedicated team to attend to these. Communities should pay for the water services, especially those who can afford it and communities also need to be part of the management of their water projects.

This study found that the District and communities should use various strategies to deal with water supply challenges, however, these strategies are not yet officially documented. Concerning the district, enough water tankers need to be made available and a reporting line link to include local councilors, preferable a toll-free number dedicated to reporting any matter relating to water should be established in the District. Concerning communities, the provision of water treatment chemicals fit for human consumption, should be made available so that communities can treat water from unsafe sources.

The VDM must also consider subsidy or vouchers for households who cannot afford to buy water at a fixed price from vendors. The non-payment of water is a severe challenge to the effective and efficient water supply systems; people should be made to pay for water services. The lack of local technicians is another issue that has resulted in problems not being resolved within a reasonable time frame. The absence of a link between the local municipality and the district is a gap that hampers the quick resolution to water problems as local councilors are not part of the water structure in terms of the legislation. If this is addressed, the water supply challenges could be promptly addressed.

7.5.2 Contribution of the research to policy

There is a need for community participation to be clearly defined, including the responsibility to manage the water project. Village water management committees need to be established, which need to be coordinated by the councilor. The village water management committee will be the vehicle where community participation and involvement will be at the center of water service delivery. The committee's role needs to be agreed upon with communities, and this recommendation should be formalized into policy directives in VDM. This amendment should need to be considered on the Local Government: Municipal Systems Act, 32 of 2000, on the role of communities in water affairs.

VDM needs to build treatment plants where fountains are available, which may be used as water sources for rural communities. A case in point is the Thulamela Local Municipality, where they

are the second leading source after piped water from the dams. Furthermore, fountains may then be used as other alternative water sources to address water supply shortages where they are situated. There is also a need for VDM to factor this activity into the Integrated Development Plan for implementation.

The mandate of VDM as the water service authority is a milestone, but there is a need to link this role with the local municipalities so that there is synergy when water is supplied to rural communities. The current state of water supply is not effective, therefore, there is a need for intervention to improve rural water supply situation in VDM. The other option may be for VDM or national government to give mandate of water service authority to the local municipality which is closer to the communities to speedily resolve water-supply challenges in rural communities. The change might need amendment to the Water Service Act legislation**.**

7.5.3 Recommendation for further research

Based on this study, some of the areas identified require further studies before or during the implementation process of the proposed intervention strategy.

a. The funding model for rural water supply systems;
b. The configuration, the roles, and responsibilities of a community-based water management system;
c. The process of deepening rural community's involvement in the operation and maintenance, management of water sources and monitoring of the systems for sustainable water supply systems in rural areas; and
d. Thorough research into the cost-effectiveness of micro-water purification plants suitable for rural areas that can be used to purify potable water from fountains and rivers.

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9. APPENDICES

9.1 Appendix 1: Ethical Clearance

Consent letter

My name is (Malima TP), a student at the University of Venda registered for (Doctoral Degree) in Rural Development (PhDRDV) degree. My research focuses on (Intervention Strategies for effective potable rural water supply systems in Vhembe District Municipality, South Africa). With this letter, I am inviting you to participate in this study. Please note that any information you will provide will be treated as confidential and therefore will not be disclosed to anyone without your consent. Your participation is also voluntary, meaning that you are free to pull out at any time should you feel uncomfortable during the course of the study.

Signature of researcher_____ Date _____

I……. have read and understood the contents and terms of this invitation to participate in this study. I hereby declare that I am voluntarily participating in this research.

Signature of Respondent _____ Date _____

REQUEST TO CONDUCT RESEARCH

The Municipal Manager

Vhembe District Municipality

Thohoyandou

0950

P.O. Box 7293

Thohoyandou

0950

Dear sir/Madam

Subject: Permission to conduct research

This communication refers:

My name is Malima TP, a PhD student in Rural Development at the University of Venda. I write this communique to request for permission to conduct research on - The Intervention Strategy for Effective potable rural water supply system in Vhembe District Municipality, South Africa which falls under your jurisdiction. Specifically, the research will be conducted amongst rural communities, traditional leaders, councillors and administrators of the municipality.

Your favourable response in this matter will be highly appreciated.

Sincerely,

Signature .....Date: ……..

9.2 Appendix 2: Data Collection Instruments

QUESTIONARE FOR HOUSEHOLD HEADS ABOUT INTERVENTION TO EFFECTIVE RURAL WATER SUPPLY SYSTEMS IN VHEMBE DISTRICT MUNICIPALITY

This questionnaire is for collecting information required for the PhD study on *Intervention strategies for effective potable rural water supply systems to communities in Vhembe District Municipality, South Africa.* The respondents of this questionnaire are heads of the households in all four local municipalities of VDM.

Questionnaire

Section 1: Personal information of respondents (I kindly request you to complete this questionnaires by a tick or cross where applicable)

Municipality: …….. Village: ……

1. Gender of respondents

Male	
Female	

2. Age of respondents

18- 29 years	
30- 39 years	
40- 49 years	
50 years and above	

3. Highest level of education attained

None	
Primary school level	
Secondary school level	
Matric	

Tertiary level	
Post Graduate Degree	
Other [Specify]	

4. Household size

Household with two people	
Household with three people	
Household with four people	
Household with more than four people	

Section 2: Extent to which potable water is supplied to rural communities

1. Where do you get your drinking water from?

Borehole	
Dam	
Rivers	
Springs/Well/fountain	
Water tanker	
Any other source? Specify	

2. How frequently do you get water from the source you stated in question 1 above?

Daily	
Once a week	
Once a month	
Once in six months	
Once per year	

3. Please rate your satisfaction with the quantity of water you receive from the main sources on the scale of 1 to 10 where 1= dissatisfied and 10 = highly satisfied. Circle your response.

1	2	3	4	5	6	7	8	9	10

4. Please rate your satisfaction with the water quality you receive in a scale of 1-10 where 1 = dissatisfied and 10 = highly satisfied. Circle your response to the question.

1	2	3	4	5	6	7	8	9	10

5. Please rate your satisfaction with the distance you travel to collect water on the scale of 1 to 10. And 1 = dissatisfied and 10 = highly satisfied.

1	2	3	4	5	6	7	8	9	10

6. What is the alternative source you use when water is not available in the main source?

Answer by making a cross on your choice

Buy from water vendors	
Collect from water tanker	
Collect from fountain	
Collect from river	
Any other source not specified	

7. Please rate your satisfaction to the quantity of water you receive from alternative sources in the scale of 1 to 10 where 1 = dissatisfied and 10 = highly satisfied?

1	2	3	4	5	6	7	8	9	10

8. How much do you pay to get water from alternative source?

< R10.00	
R10.00 to R35.00	
>R35.00	
Free	

Section 2: Community's coping strategies

1. Which water supply systems is used in your village? Are the systems functional?

Name the system	Indicate functionality

2. What are the challenges related to water supply system in your area? Kindly indicate by cross on your choice.

Breakdown of the system, lack of maintenance, old age infrastructure, vandalism of infrastructure, poor security and illegal connection	
Limited sources and resources	
Few operation hours and little pressure of water supply.	

3. What do you suggest should be done to address the water supply system challenges? Kindly indicate by putting a cross on your choice.

Add more sources	
Maintain the system and buy spare parts	
Employ youth/new staff	
Establish village water committees	
Increase operational times	
Change from diesel to electricity energy supply to borehole	

4. When the water you receive is not of good quality, what do you do? Kindly indicate by putting a cross on your choice.

Boil water	
Use water as is	
Pour one tablespoon of Jik	

Section 3: Effectiveness of water supply service

1. Are the main water sources effective in supplying water to rural communities?

   _____

   _____

   _____

2. Please rate the water supplier's services you receive, in the scale of 1 to 10 considering 1 = Poor and 10 = Good?

1	2	3	4	5	6	7	8	9	10

3. Is the water supply system you use reliable? Rate from 1 = not reliable and 10= highly reliable.

1	2	3	4	5	6	7	8	9	10

4. Are you willing to pay for the water supply services?

Yes	
No	

5. How would you rank as the level of effectiveness of community participation for domestic water supply service in a scale of 1 to 10 where 1= very poor and 10 = very good?

1	2	3	4	5	6	7	8	9	10

Thank you

QUESTIONAIRES ABOUT INTERVENTION TO EFFECTIVE RURAL WATER SUPPLY SYSTEMS IN VHEMBE DISTRICT MUNICIPALITY

A DATA COLLECTION TOOL FOR COUNCILLORS

Name of Local Municipality ……

Name of the Ward ……

Name of the Village ……

Venue of the engagement ……

II. BIODATA OF PARTICIPANTS

Instructions: Individually, kindly complete the section below as carefully, truthfully and as detailed as possible.

1. Gender of respondents

Male	
Female	

2. Age of respondents

<18	
18- 29 years	
29- 40 years	
41- 52 years	
53 years and above	

3. Highest level of education attained

None	
Primary school level	
Secondary school level	
Matric	
Tertiary level	
Post Graduate Degree	
Other [Specify]	

4. Position held in the community by the Respondent

Household/head	
Traditional Leader	
Councilor	
Water-related technician	

III. RURAL WATER SUPPLY RELATED ISSUES

Section 1: Extent to which potable water is supplied to rural communities

1. Where do you get your drinking water from?

Municipal water supply	
Borehole	
Rivers	
Fountain	
Any other source? Specify	

2. How frequently do you get water from the source you stated in question 1 above?

a) ……

b) ……

Section 2: Community's coping strategies

1. What are the challenges related to water supply system in your area? Kindly indicate by putting a cross on your choice.

Breakdown of the system, lack of maintenance ageing infrastructure, vandalism of infrastructure, poor security and illegal connections	
Limited sources and resources	
Few operation hours and little pressure of water supplied.	
Any other challenge(s)	

2 How long does it take the municipality to respond to water-related problems?

More than a year	
Three months	
One months	
One week	

3 What do you suggest should be done to address the water supply system challenges? Kindly indicate by putting a cross on your choice.

Add more sources	
Maintain the system and buy spare parts	
Employ youth/new staff	
Establish village water committees	
Increase operational times	
Change from diesel to electricity energy supply to borehole	

Section 3: Effectiveness of water supply service

1. Is the water supply systems to the community households in your areas reliable?

Reliable	
Not reliable	

2. Are households paying for water supply service in your areas?

Yes	
No	

3. How would you rank the level of effectiveness of domestic water supply service in terms of funding, infrastructure, technicians' assistance and involvement of community?

Level	**funding**	**Infrastructure**	**Technicians**	**Involvement of community**
Very good				
Good				

Poor				
Very poor				

4. Do maintenance officials respond quickly to water-related problems?

Yes	
No	

5. Is maintenance of water supply systems?

Yes	
No	

6. What is the process should be followed to inform the municipality about the breakdown in water supply system? Kindly indicate your choice by a cross.

Community > Councilor > VDM	
Traditional leader> Councilor > VDM	
Traditional leader > Traditional Council > Councilor > VDM	
Councilor > VDM	

Thank you

DATA COLLECTION TOOL FOR FOCUS GROUP DISCUSSION (COUNCILORS, TRADITIONAL LEADERS, HOUSEHOLDS)

This is a focus group discussion guide/schedule for participants in the local municipalities of Vhembe District Municipality, which are Thulamela, Makhado, Musina and Collins Chabane.

FOCUS GROUP DISCUSSION GUIDE/SCHEDULE

Name of the District Municipality

Name of the Village ……...

Venue …….

Group ……..

Date ……

INTRODUCTION

I would like to thank you all for agreeing to be part of this discussion and wish to stress that what you say will be held in strict confidence. The study will address the following objectives outlined below: Position held in the community by the Respondent

Household/head	
Traditional Leader	
Councilor	

III. RURAL WATER SUPPLY RELATED ISSUES

Section 1: Extent to which potable water is supplied to rural communities

1. List your main sources of drinking water starting from the most used to the least used, location of the source, distance and indicate if it is protected or not?

Source	**Location of the source i.e. in the yard or outside**	**Distance**

2. For each source in number 1 indicate whether the sources are protected or not and give reasons for that?

Sources	**Is the source protected?**	**Not protected**	**How is it protected?**	**If not why it is not protected?**

3. Indicate how frequent you get water from the sources in question 1, quantity collected per day, time spent and if you are satisfied about water you receive as per table below?

Sources	**Frequency of water received**	**Quantity collected per day**	**Time spent**	**Are you satisfied about water you receive?**

4 What would you say about the quality of the water you receive from sources you mentioned in question 1 in terms of table below?

Sources	**very good,**	**Good**	**Poor**	**Very bad**	**Any comment**

5. List alternative sources you use when you do not get water from the main source?

a) ……

b) ……

c) ……

6. From the alternative sources listed in question 5, what quality, quantity, at what cost, distance and time is water collected, indicate this in the table provided below:

Alternative sources	**Quantity**	**Quality**	**Cost**	**Distance**	**Time**	**Are you Satisfied?**

7. What are the main challenges related to water supply systems in your area? List the challenges

a) ……

b) ……

c) ……

Section 2: Community's coping strategies

1. When the water you receive is not of good quality, what do you do?

a) ……

b) ……

2. When the water is not available at all, how do you deal with the situation?

a) ……

b) ……

3. When the water is not available at all, how does the municipality deal with the situation?

a) ……

b) ……

4. How do you conserve water for future use?

a) ……

b) ……

Section 3: Effectiveness of water supply service

1. Who is responsible for supplying water to your area?

a) ……

b) ……

2. How would you describe the water supply services you receive?

a) ……

b) ……

3. Which water supply systems is being used to supply water in your area?

a) ……

b) ……

4. Has there been water related diseases in your area?

a) ……

b) ……..

5. From each of the above, how reliable is the water supply system to the community in your areas?

System used	**Is the system reliable?**	**Reason(s)**

6. Do you pay for the water supply services in your community?

a) ……..

b) ……

7. For the following water supply service who pays and why, answer as per table below?

Service	**Do you pay?**	**If yes why?**	**If no who pays?**
Water supply			
Infrastructure			
Maintenance			
Water supply system			

8. What do you suggest could be done to improve the water supply services to community households in the rural areas?

a) .....

b) .....

c) ……

9. How would you rank as the level of effectiveness of domestic water supply service in terms of funding, infrastructure, technicians' assistance and involvement of community?

Level of satisfaction	funding	Infrastructure	Technicians	Involvement of community
Very good				
Good				
Poor				
Very poor				

10. List the main challenges that causes water supply failures, frequencies, who intervene and how long intervention is made?

List of challenges	Frequency of occurrence	Who intervenes?	How long does it take to solve the problem?
a.			
b.			
c.			

11. What is the process followed to inform the municipality about the breakdown in water supply system?

a) ……

b) ……

c) ……..

12. Is maintenance of the water supply systems done? If not why?

a).....

b).....

c) ……

13. Would you say that the people responsible for operations and maintenance of water supply systems respond well to the problems? Tick in the boxes below.

a) Yes □ b) No □

14. In your view, what do you think are the reasons for lack of quick responses?

a) ……

b) ……

15. What are your roles and responsibilities in dealing with water supply challenges in your village or area of operation?

a) ……

b) ……

16. What do you suggest should be done to improve the water supply system challenges?

a) ……

b) ……

INTERVIEW GUIDE ON INTERVENTION TO EFFECTIVE RURAL WATER SUPPLY SYSTEMS IN VHEMBE DISTRICT MUNICIPALITY

Position of the respondent .....…….....

Name of Municipality the respondent is located ……..

QUESTIONS

1. Where does the portable water (domestic) supply in the Vhembe District Municipality come from?
   a) .....
   b) .....
   c) ……

2. What are the cost implications for the supply of portable water services to rural community households?
   a) .....
   b) .....
   c) ……
3. Does the cost of water take into cognizance the poverty levels or location of the households? *Tick in the box.* Yes □ No □
   d) If it does, how? .....
      ……
      ……
4. How effective is the water payments among the rural community households?
   a. .....
   b. .....
   c. ……..
5. What are the water supply systems that are currently being used to provide water to the community households in the rural area of Vhembe District Municipality?
   a) .....
   b) .....
   c) .....

6. What would you say is the situation or status of the current water supply systems in Vhembe District Municipality?
   a) .....
   b).....
   c).....

7. How effective have the water supply systems been since 1995?
   a) .....
   b) .....
   c) .....

8. Who is responsible for the maintenance of rural water supply systems at the district level, local municipality level, and ward level and at village level? How effective is maintenance in rural water supply systems?

   a) District level? .....
   b) Local Municipality level? .....
   c) Ward level? .....
   d) Village level? .....

9. What are the rural water supply systems challenges that you face when supplying water to the rural community households?
   a) .....
   b) .....
   c) .....

10. What monitoring strategies are in place to ensure that water supply systems are functional and that community households in the rural areas receive domestic water?
    a) .....
    b) .....
    c) .....

11. What is your role in the delivery of water to the rural community households in the rural areas of Vhembe District Municipality?
    a) .....
    b) .....
    c) .....

12. What strategies do you have in place that guide the supply of water to rural community households?
    a) .....
    b) .....
    c) .....
13. What coping mechanisms have been put in place to mitigate water supply in case of system failure?
    a) .....
    b) .....
    c) .....
14. What challenges do you experience that hinder effective implementation of rural water supply systems?
    a) .....
    b) .....
    c) .....
15. Kindly give us an approximate annual expenditure on water supply to rural community households.
    a) .....
    b) .....
    c) .....
16. How much are communities paying for water services?
    a) .....
    b) .....
    c) .....
17. How effective is the payment system?
    a) .....
    b) .....
    c) .....
18. In case of system failure, what are the coping strategies?
    a) .....
    b) .....
    c) .....

End

Thank you for being part of the study