

# **Impacts of hydrological drought management on sustainable livelihood in QwaQwa, South Africa**

**By**

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## DECLARATION

I Mpho Jason Manyama, hereby declare that this dissertation titled **Impacts of hydrological drought management on sustainable livelihood in Qwaqwa, South Africa** at the University of Free State is my own work and that all sources used and cited have been acknowledged by means of referencing. I further declare that this work has not been submitted elsewhere for academic or non-academic purpose.

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Date: \_\_\_\_\_

## DEDICATION

I would like to dedicate this work to the following people:

- My beloved parents, my late father Nakampe Edward Manyama and my mother, Mokete Suzan Bilusa who raised me and taught me how to pray and be the best I can be.
- My beloved wife, Nkosinathi Manyama who has supported me by giving up her time with me to ensure that I complete my studies.
- My beloved children, Mpho Manyama (son) and Bontle Manyama (daughter), for giving up the time which they should have spent with their father.
- Everyone who believed in me, for your supportive words and encouragement.

Above all, gratitude and honour to Almighty God for strength and grace.

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## LIST OF ABBREVIATIONS AND ACRONYMS

<b>Abbreviations</b>	<b>Description</b>
<b>RSA</b>	Republic of South Africa
<b>DCM</b>	Drought Cycle Management
<b>DFID</b>	Department for International Development
<b>WWF</b>	World Wildlife Fund
<b>DWS</b>	Department of Water and Sanitation
<b>NDMF</b>	National Disaster Risk Management Framework
<b>NWRS</b>	National Water Resources Strategy
<b>SPSS</b>	Statistical Package for the Social Sciences
<b>COGTA</b>	Department of Cooperative Governance and Traditional Affairs
<b>IPCC</b>	Intergovernmental Panel of Climate Change

## ABSTRACT

Water plays an important role in an economy, environment and sustainable development. However, water shortage can really threaten the sustainability of the livelihood activities of people. Drought, is one of the disasters that has recently affected most countries including South Africa. The effect of drought can be realised in food insecurity that poses serious threats to people's livelihoods.

The study explores the effects of the impact of hydrological drought in Maluti-a-Phofung Local Municipality, focusing on the community of QwaQwa. The objective of the study is to determine how the municipality is managing hydrological drought, in order to provide sustainable service delivery. In addition, the study addresses how community members are empowered to live and mitigate drought.

The study was conducted with the employees of the Maluti-a-Phofung Local Municipality and the community of Qwaqwa. Qualitative and quantitative methodologies were employed using purposive sampling. A sample size of one hundred and forty-eight (148) respondents was used wherein one hundred and ten (110) were community members; thirty (30) were municipal officials at non-management level; and eight (8) municipal officials at management level. Selected questions were used to collect the data to fit the research questions of the study. The experience of the impact of drought among females and males was tested using t-test in analysing the hypothesis.

The study findings revealed that some hydrological drought management aspects were not managed properly which had impact on a shortage of water to the community. Furthermore, the results reveal that the majority of community members were highly affected by poor service delivery where the quality of water supply was not according to norms and standards as prescribed by legislation. Communities were not fully empowered through early warnings and water was delivered in different forms, such as boreholes, water trucks, and where the community was unable to get water, unprotected wells were used.

The study recommends that the municipality prioritise the implementation of a disaster management framework as prescribed by legislation. National and Provincial government should support the municipality with technical and financial resources. Community involvement and empowerment should be an integral part of disaster management.

# **CHAPTER 1**

## **INTRODUCTION AND BACKGROUND TO THE STUDY**

### **1.1 INTRODUCTION**

Water Service Authorities are often faced with hydrological drought management challenges that affect their operations for water supply to communities (Van Lanen, Laaha, Kingston, Gauster, Ionita, Vida, Vlnas, Tallaksen, Stahl, Hannaford, & Delus, 2016). The problems faced can be due to a lack of the proper management of hydrological drought. Improper management of hydrological drought can affect the availability of water to the environment, social development and the economy in general.

The study highlights the importance of the proper management of hydrological drought to ensure water supply to communities during drought. It further highlights the importance of water in rural livelihood activities of our people and analyses how drought can affect the food security of local communities in the Qwaqwa area of South Africa. This chapter consists of the background to the study; the problems addressed in the study; the aim and objectives, and the conceptual framework. Finally, it provides a brief outline of the mini dissertation.

### **1.2 BACKGROUND OF THE STUDY**

Water resources plays an important role in any country's socio-economic development and environment as a whole (Estrela & Vargas, 2012). Water shortage has become a global concern due to increasing water demand by population (Hardy, Cubillo, Han, & Li, 2015). This in turn, has resulted in most developing countries facing challenges of water unavailability (Starkey, 2012). The problem of water scarcity can affect development, environmental and sustainable livelihoods activities of human negatively (UNEP, 2007). Drought has added to the problem of water shortages in developing countries across the world.

As a global problem, drought affects millions of people worldwide (Van Loon, Van Huijgevoort, & Van Lanen, 2012). Primarily, drought is a result of natural reduction of rainfall received over a long period and is also known to be a natural hazard (Wilhite, 2000). Prolonged and frequent occurrence of droughts can place significant stress on water resource management, agriculture and the environment, leading to food insecurity (Keshavarz, Maleksaeidi, & Karami, 2017). Drought that causes food insecurity poses serious threats to people's livelihoods and to socio-economic development in general.

South Africa is a semi-arid region with low rainfall that causes water scarcity. The drought that occurred between 2015 and 2016 has increased water shortages (Baudoin, Vogel, Nortje, & Naik, 2017). The drought affected eight (8) provinces in South Africa causing most dams and rivers to nearly dry up (Meissner & Jacobs-Mata, 2016). According to the Department of Water and Sanitation (DWS) (2016), municipalities faced water supply shortages with most having no contingency plans to address the water shortages. According to Meissner and Jacobs-Mata (2016), lack of proper planning and coordination of information on water resources and the sectoral response have created a reactive response towards drought instead of being proactive.

The DWS as the custodian of water resources in South Africa prioritised about R502 million to manage drought challenges in the 2016/2017 financial years (RSA DWS, 2016). However, due to lack of planning and coordinated mitigation plans, implementation of drought was mostly focused on water tankers and drilling of boreholes for water supply in communities (RSA DWS, 2016). A similar trend was noticed in the Mediterranean in the year 1998, where the planning was not coordinated properly and did not include short-, medium-, and long-term plans to address drought impacts (Hamdy and Trisorio-Liuzzi, 2008). As a result, people's livelihoods and the economy were negatively impacted because of improper planning and mismanagement of the hydrological drought.

### **1.3 PROBLEM STATEMENT**

According to Cook and Bakker (2012), eighty (80) percent of the world's population faces high-level water insecurity risk. Water security relates to availability of water resources

for humans and ecosystems. It includes the issues of water quality and quantity for livelihoods and ecosystem services.

The Free State Province of South Africa was faced with drought between the years of 2015 and 2016. It was declared a disaster area in terms of drought management on 14 August 2015 (RSA DWS, 2016). Section 53 of the Disaster Management Act of 2002, stipulates that municipalities must prepare disaster management plans. Furthermore, there should be proper coordination and alignment of their implementation plans with the provincial and national government including other related institutions that are affected. According to the Department of Water and Sanitation (2016), municipalities in Free State were found not having drought management plans and not able to manage drought accordingly.

Maluti-a-Phofung Local Municipality was one of the municipality that were faced by drought. Their water dam levels were low during the year 2015. One of the dams that supplies water to the community of Qwaqwa which is Fika Patso was reported to be almost dry in the year 2015 (RSA DWS, 2016). The community of Qwaqwa was without water for most of the time during the drought period and this raised serious concerns about water security in that community (RSA DWS, 2016). Furthermore, most women and children were seen by DWS officials waiting for the water tanker to get water.

#### **1.4 AIM OF THE STUDY**

The aim of this study was to explore the municipal practices of hydrological drought management and their impacts on sustainable livelihoods. The study used Maluti-a-Phofung Local Municipality as a case study, focusing on the community of Qwaqwa. The study further recommends active drought intervention practices that could assist in improving hydrological drought management to promote the sustainable livelihood of the community of Qwaqwa.

## **1.5 OBJECTIVES OF THE STUDY**

The objectives of this study were to:

- Assess the effect of hydrological drought management on sustainable livelihoods in the community of QwaQwa;
- Determine how the municipality managed to intervene to reduce drought risk;
- Propose recommendations on drought management at municipal level;and
- Determine how male and female experience the drought effects in QwaQwa.

## **1.6 THE RESEARCH QUESTIONS**

The research questions serve as a guideline to the path of the research and therefore, should be clearly outlined. Clear formulation of the research question is an important step when conceptualising a study (Flick, 2009). Research questions serve as a tool to check the accuracy of the research design and proper methods used for collecting and interpreting the data.

The research questions this study aims to address are as follows:

- Is hydrological drought managed properly to ensure water supply to the community?
- What are the effects of hydrological drought on community members?
- What are the intervention plans of the municipality to mitigate drought?
- Are the communities empowered to overcome the effects of drought?
- How female and males experienced the drought effects?

### **1.6.1 The hypotheses of the study**

#### **1.6.1.1 *Null Hypothesis***

There is no difference between female and male on the experience of drought effects in Qwaqwa.

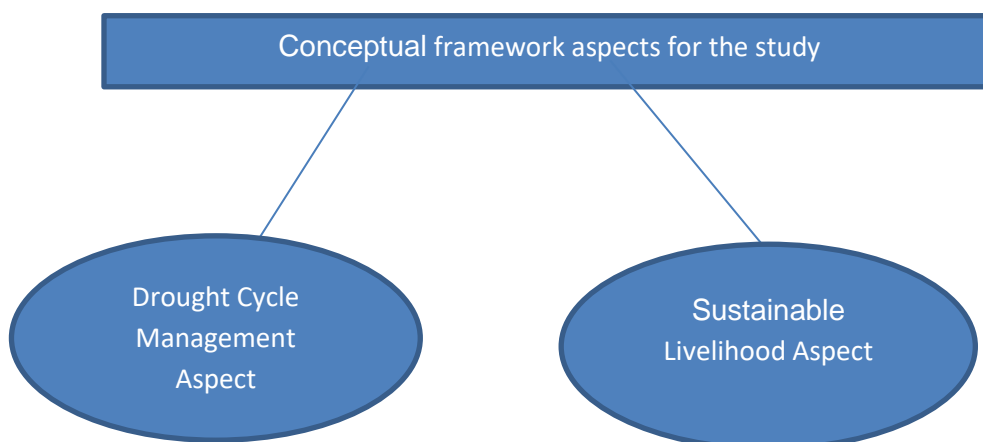


### 1.6.1.2 *Alternative Hypothesis*

There is a difference between female and male on the experience of drought effects in Qwaqwa.

## 1.7 CONCEPTUAL FRAMEWORK

A conceptual framework of the study serves as a tool for mapping a pathway for research and providing guidance for the research. The importance of a conceptual framework is to show the origin of the study, test the existing theory, and apply the theory of the research to address the study question (Bless, Higson-Smith, & Kagee, 2006). The conceptual framework for this study focuses on two aspects, namely drought cycle management and sustainable livelihood. The study looked at how people's lives were impacted by hydrological drought. In addition, the study interrogated on how to improve drought mitigation and drought management practices. Water Service Authorities are tasked with the responsibility for water resource management and water and sanitation service delivery in their respective areas. The figure 1.1 below provides a conceptual framework of this study.



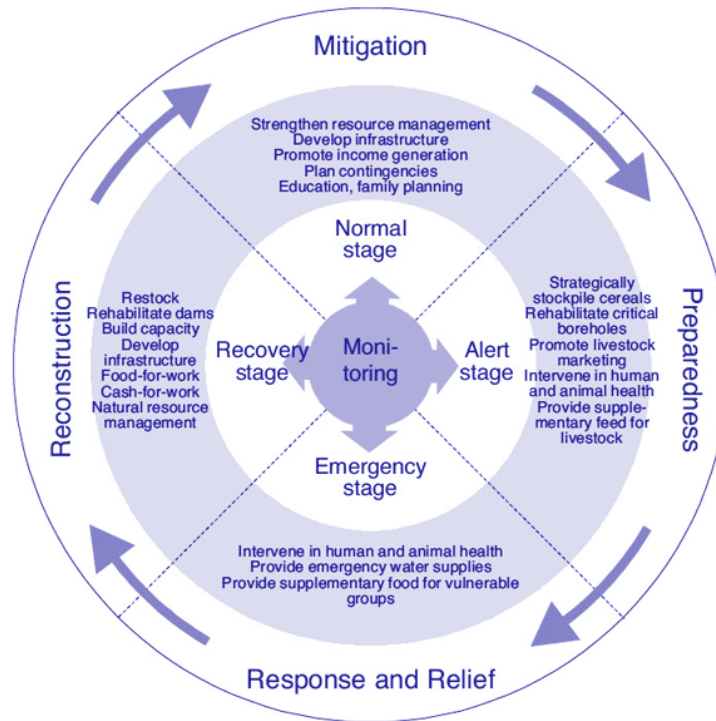
**Figure 1.1: Conceptual framework aspects for drought cycle management and sustainable livelihood**

### **1.7.1 Drought Cycle Management**

Historically, drought has been seen as a once-off disaster requiring an emergency response such as food and life-saving support including the refurbishments of boreholes and emergency vaccination campaigns (Oxfam, 2009). However, this method limits the sustainability of drought interventions, since it is viewed as once-off episode. Given the frequency of drought in many regions, a lot of developmental works have been increasingly disrupted due to the urgent response towards drought.

During the late 1980s and 1990s, drought started to be seen as a normal occurrence mostly in pastoral and dry land areas (Oxfam, 2009). The model of Drought Cycle Management (DCM) started emerging as a tool to manage drought, since drought is now seen as normal disaster occurrence.

Drought Cycle Management is an approach that seeks to provide guidance on how to manage drought and reduce risks associated with drought (CORDAID, 2004). It further realises that droughts are a normal, unavoidable part of climate and will occur anyway (Muhuba, 2013).



Source: Adapted from IIRR, ACACIA & CordAid (2004: 41)

**Figure 1.2: Drought Cycle management**

The Drought Cycle Management Model aims to build resilient local communities by reducing their vulnerability to drought risk through increased coping capacity at the household level. It also enables them to withstand the impact of drought successfully, through sustainable livelihood measures (World Meteorological Organization (WMO) & Global Water Partnership (GWP), 2014).

### **1.7.1.1 Mitigation-Normal stage**

Mitigation efforts are helps in preventing hazards that may develop into disasters. The mitigation phase focuses on long-term measures that will result in reducing or eliminating risk, rather than other phases (Wilhite, 2016). These measures can be structural or nonstructural. Structural measures are measures using technological solutions while nonstructural ones include legislative measures, such as bylaws, public awareness campaigns, contingency planning and buying insurance. According to Wilhite (2016), mitigation is a cost-efficient method for reducing the negative effects of hazards.

At this stage in which rainfall is still sufficient, institutions should focus in strengthening their water resource management and improve water infrastructures, while also ensuring the payments of services, so as to have funds to maintain infrastructure. The community should be educated about water conservation and demand management to reduce water losses (CORDAID, 2004).

### **1.7.1.2 Preparedness-Alert stage**

First, preparedness is a continuous process of planning, organising, training, equipping, practising, monitoring, evaluation and educational activities to ensure proper coordination. Second, it entails the development of resources and capacity to prevent, and mitigate the negative effects of natural disasters (Wilhite, 2016). Third, during a drought emergency, managers are required to develop actionable plans in order to build up the necessary capabilities and control to counter the drought risks (Wilhite, 2016). Furthermore, managers are expected to strategically identify key water resources and rehabilitate them accordingly (CORDAID, 2004). They should develop a proper emergency plan that will enable them to cope with drought events.

According to the World Meteorological Organisation(WMO) and Global Water Partnership (GWP) (2014), the following has to be considered in order for managers to achieve an efficient and effective drought emergency plan:

- The drought communication plans should be easily understandable with simple terminology and methods.
- Proper maintenance of emergency equipment and training of emergency personnel together, be considered as emergency services.
- Develop and implement emergency early warning systems.
- Stockpile and maintain an inventory of disaster supplies and equipment.

### **1.7.1.3 *Response-Emergency stage***

The response phase talks to efforts taken in the provision of services or intervention during drought to protect the lives of people by providing basic subsistence needs to those affected (WMO and GWP, 2014). At this stage, communities expect water supply and the institutions are expected to provide emergency water supply as relief (CORDAID, 2004). Water supply can be done through tankering and boreholes that have been rehabilitated.

### **1.7.1.4 *Recovery-Reconstruction stage***

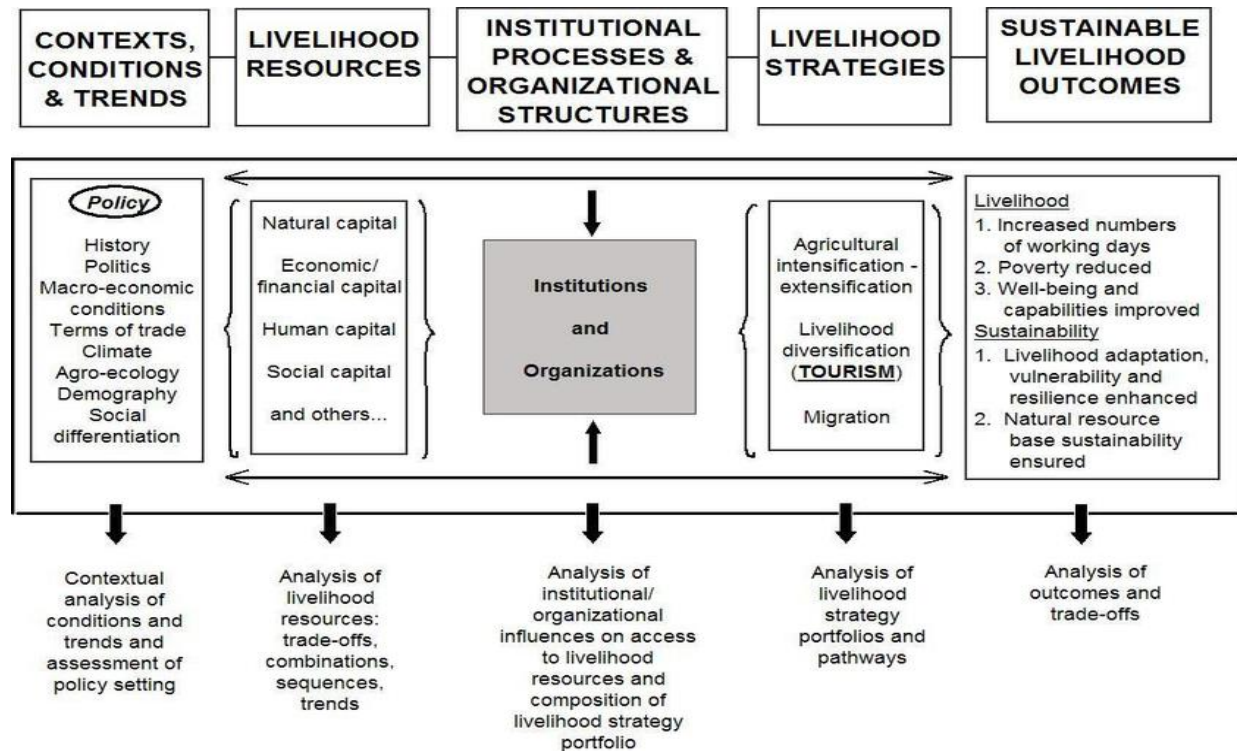
The aim of the recovery phase is to ensure restoration or improvement of the living conditions of the communities affected, while promoting and facilitating the necessary measures to reduce drought risks (WMO and GWP, 2014).

## **1.7.2 Sustainable Rural Livelihoods**

The sustainability of rural livelihoods is more focused around rural development, the reduction of poverty, and management of the environment (Scoones, 1998). Rural development is about promoting policy development, economic growth, and improving the quality of life (Chambers, 2014). Community's livelihood is sustainable when they have capabilities, assets, and strategies that enable them to cope and recover from stresses and shocks, while considering environmental sustainability (Chambers & Conway, 1992).

According to the Department for International Development (DFID) (2001), public participation forms part of sustainable livelihood, with the community identifying and resolving their own poverty challenges. According to Cherutich (2012), the sustainable livelihoods approach has been used in many institutions to analyse ways in which people can use their resources to sustain their living conditions and improve an understanding of their livelihood strategies.

A sustainable livelihoods framework, as presented below in figure 1.3 seeks to describe sustainable livelihood elements that revolve around socio-economic development, with the intention of reducing poverty (Petersen & Pedersen, 2010).



Source: Adapted from Scoone (2015:36)

**Figure 1.3: The sustainable livelihoods framework**

The sustainable livelihoods framework embodies five components as per figure 1.3 presented above. These components are interlinked and can lead to sustainable livelihood outcomes when implemented properly. The five components of sustainable livelihoods are discussed below.

### 1.7.2.1 Context

Context refers to the conditions people are living in (DFID, 2001). There are different conditions that people live in, such as climate, natural disaster risks (i.e. drought), and other related issues that might affect their living conditions.

### **1.7.2.2 Livelihoods resources**

All these conditions can affect the livelihood resources of the people concerned. Livelihood resources include natural capital; economic capital; human capital; and social capital (Scoones, 1998). Drought can easily affect the state of these livelihoods resources if not properly managed. However, drought can be properly mitigated if their institutional and organisational structures are in good condition and well capacitated (Van Loon, 2015).

### **1.7.2.3 Institutional process and organisational structures**

These organisational structures referred to are government, the private sector, and tribal authorities, while the processes are the laws, policies, and culture that govern the people (Scoones, 1998). These organisational structures should be aimed at creating an enabling environment for people to cope and survive during disasters.

### **1.7.2.4 Livelihood strategies**

This refers to an enabling environment for people to explore the capabilities and strategies to achieve a sustainable livelihoods. According to Scoones (1998), people are able to come up with livelihoods strategies when they are in an environment that does not restrict them.

### **1.7.2.5 Sustainable livelihood outcomes**

According to Scoones (1998), examples of sustainable livelihood outcomes are improved food security, increased income, improved well-being, reduced poverty, and sustainable use of resources.

## **1.8 CHAPTER OUTLINE**

The study is presented under the following chapters:

### **Chapter 1: Introduction and background to the study**

This introductory chapter outlines the background; problem statement; the importance and significance of the research, the aim and objectives of the research; the research questions, and the hypothesis of the research, as well as the conceptual framework of the study.

### **Chapter 2: Literature review**

In this chapter, a review of the theoretical concepts and models regarding drought management and sustainable livelihood is presented. Theories of development and models of sustainable livelihoods are explained. The literature review is used to gain more insight into the linkages between the management of drought and sustainable livelihoods. Selected theories of development are also explained, relevant to the study.

### **Chapter 3: Research methodology**

Chapter three (3) outline the research design and methodology used to address the research problem and answer the research questions. To this end, this research employed a mixed method approach in order to achieve the research aim and objectives. This research employed a combination of the qualitative and quantitative approach to get the views of community members of Qwaqwa and the management of Maluti-a-Phofung Local Municipality regarding hydrological drought in their area.

### **Chapter 4: Findings and discussion**

Chapter four (4) discusses the results from the statistical analyses and the findings from the qualitative content analyses processes. The chapter gives a brief review of the data analysis that produced the results. The findings reveal the perceptions of whether good practice of hydrological drought management can reduce the impact of drought at the community level.



## **Chapter 5: Summary, recommendations and conclusions**

Chapter five (5) of this study will present a summary of the findings in relation to the objective of the study. The chapter will further provide recommendations on the best ways of managing and coordinating a hydrological drought management system to ensure sustainable livelihoods in Qwaqwa. Finally, the chapter will provide a conclusion that highlights best practices on the management of hydrological drought by South African municipalities.

## **CHAPTER 2**

### **LITERATURE AND THEORETICAL REVIEW OF THE STUDY**

#### **2.1 INTRODUCTION**

This chapter presents a review of the literature on hydrological drought management and sustainable rural livelihoods. The chapter further review strategies used by the municipality in addressing drought; understanding of municipal drought mitigation plans; and how community was affected by drought. Lastly, the chapter also presents an overview of climate change, water resource management challenges faced globally and linked to hydrological drought including drought policies and strategies supposed to be used by the municipalities when mitigating drought.

#### **2.2 CONCEPTUAL OVERVIEW OF DEVELOPMENTAL THEORIES**

Historically, the term development has been associated with economic growth. The term surfaced in the United States (US) in the beginnings of the 1940s. The focus by then was centred on foreign policy to support the future of newly independent countries (Halperin, 2018). The goal of the US was to promote economic development and political stability in developing countries. Generally, developmental theories have been mapping the direction of development in many developing countries.

Developmental theory is defined as a concept that focuses on developmental goals which include absolute growth and sustainable growth that enables practical means to achieve desirable changes in the society (David & Theron, 2014). Historically, development theories were more focused on economic growth and less on the social aspects of development. Later in the 1980s, the focus started moving towards social development theories (David & Theron, 2014). In this study, the theory of people-centred development will be discussed.

## **2.2.1 People-centred development theory**

People-centred development is that which seeks to improve the lives of people benefiting from development through social justice, self-reliance and participating in decision making (David & Theron, 2014). The theory is centred on the notion that people know what they want and should take part in any development that happens in their environment. Community members know their situation better than anyone outside their environment. Public participation, community empowerment, stability and social learning are the key concepts in the theory of people-centred development.

### **2.2.1.1 Participation**

Public participation has become part of development since the late 1960s and early 1970s. In most developing countries the idea was not received well as it was seen as a threat to their existence (Kotze & Kellerman, 1997). Today, public participation is viewed as a basic need and a democratic right for development to take place (Swanepoel & Beer, 1997). Potter (1985) further indicated that public participation should be a two-way interchange of decision making but not be confused with involvement or consultation in development. Participation includes the sense of participating in decision making processes; implementation; monitoring; sharing of the benefits and the evaluation of development (Yadav, 1980). Community members should participate during drought interventions, since they are aware of their surroundings. They are able to give historical information on the ground water sources in the area.

Although public participation is seen to have its constraints of being time consuming and costly which might delay the project start, it is important for people to participate in their development, so as to create ownership and be able to maintain it (Yadav, 1980).

### **2.2.1.2 Social learning**

The concept of social learning is on the basis that people should be allowed to participate on the basis of their knowledge, skills and creativity (David & Theron, 2014). Social

learning can be likened to empowering the community or people. Their understanding and culture of doing this should always be respected. Community members should be allowed to use their knowledge about the area to assist in dealing with drought.

### **2.2.1.3 Empowerment**

According to the White paper on Reconstruction and Development (1994), development is about involvement and empowerment of the people. Empowerment can be defined as way of stimulating others and raising their morale to a point where they are able to reach their potential to do something. Empowerment brings a sense of ownership in any development project.

Community members should understand and own any development or programme happening in their vicinity. If communities are not involved, the development will end up being vandalised by the very same community that should be protecting it. McWhirther (1991) emphasises that empowerment is a process of personal development of the community members, while advocating collective action towards development. In the process of mitigating drought and drought interventions, it is important that community members be involved and be empowered.

### **2.2.1.4 Sustainability**

Development of the people is not supposed to harm the environment in which they live. People should be accepted along with their environment. Proper implementation of this understanding leads to a sustainable environment.

According to the World Commission Environmental and Development report (1987), people on their quest for development, were seen to be slowly destroying their natural environment. This kind of development did not promote sustainable development. Sustainable development is one that ensures the integration of the environment with social and economic aspects (Emas, 2015).

## 2.3 OVERVIEW OF CLIMATE CHANGE AND GLOBAL WATER RESOURCE CHALLENGES

According to Intergovernmental Panel of Climate Change (IPCC) (2013), during the 21<sup>st</sup> century, global warming is expected to increase. Climate change has been cited as one of the contributing factors to the water resource scarcity (Su, Zhang, Ou, Chen, Yao, Tong, & Qi, 2016). Climate change is referred to as the state of climate that changes overtime.

According to Moloela and Sinha (2011), climate change results in extreme temperatures that can lead to floods, drought, storms, and extreme events. These challenges are attributed to the difficulty in managing water resources. Climate change is becoming a major problem in many developing countries and as with many developing countries, South Africa is also facing climate change.

According to Engelbrecht *et al* (2015), the temperature of South Africa is warming faster than the global average trends. The mean annual temperature in South Africa is projected to increase by 1.5°C, compared to the global average of 0.85°C (Jury, 2013). Owing to the increase in global warming, extreme events are expected (IPCC, 2016).

As a result of global warming, the frequency, duration and severity of drought episodes are projected to increase in many areas (Duffy, Brando, Asner, & Field, 2015). These increases have been found to be especially significant in Africa and South Africa was found to be one of the countries experiencing the severest problems (Spinoni, Naumann, Carrao, Barbosa, & Vogt, 2014).

According to Meissner & Jacobs-Mata (2016), drought has proved to have serious negative on the environment and socio-economic of South Africa. During the period of 1992/93, drought resulted in crop failures and the loss of jobs in the agricultural sector (Ngaka, 2012).

According Dallas and Rivers-Moore (2014), an increase in climate change in South Africa has seen to be affecting both water quality and quantity availability through changes in evaporation and changes in temperature. South Africa will require a drought preparedness plan to be able to manage the effects of climate change. A proper drought

preparedness plan will require reliable information with resources, such as early warning systems and capacity to develop mitigation and management plans (Meissner & Jacobs-Mata, 2016).

Dellapenna and Gupta (2009) further indicate that solution to water resource management requires majority of the countries to adapt to changes by promoting good governance and advanced technologies to improve management of water resources. Properly management of hydrological drought should be able to create ability to predict changes in the geo-hydrological systems, even though it has proved to be complex and remains unpredictable (Duffy *et al.*, 2015). According to Meresa, Osuch, & Romanowicz (2016), climate change models remain essential tools for predicting future climate changes and institutions, including municipalities, should be able to use the information to prepare, mitigate and manage drought efficiently.

## **2.4 WATER RESOURCE CHALLENGES IN SOUTH AFRICA**

Water may appear to be occurring in almost any place on earth; however, its availability, quantity, and quality determines its uses (Biswas, 2004). In developing countries, access to water for drinking and water for agricultural use is becoming a major problem (Molobela & Sinha, 2011). Due to population growth, excessive use of surface water and groundwater, and its failure to meet the demand among developing countries has been increasing for a number of years (Molobela & Sinha, 2011).

The country receives an average rainfall of 490mm per annum. Furthermore, South Africa's population growth has contributed significantly to the use of water resources, despite their scarcity (Molobela & Sinha, 2011). According to WWF (2016), about 30 percent increase in the national water demand is expected by 2030. Most rural areas are highly dependent on water resources for their survival as South Africa has high unemployment rates (Egoh, Reyers, Rouget, Richardson, Le Maitre, & van Jaarsveld, 2008).

Added to the challenges of water scarcity, pollution is a contributing factor to water resource management problems. Chigor, Sibanda and Okoh (2013) states non-

compliance of final effluent discharged by water users has caused serious pollution in most rivers and dams. Due to the pollution of rivers and dams which often render water unsuitable for use, water shortages are thus worsened during drought exacerbated by the high cost of water treatment. Many municipalities have been seen to be struggling with the issues of water resource management, due to a lack of capacity to monitor their resources. The high maintenance of water resource infrastructures has been escalated by a lack of payment for services by communities

## **2.5 WATER RESOURCES IN MALUTI-A-PHOFUNG LOCAL MUNICIPALITY**

Maluti-a-Phofung Local Municipality depends on four (4) water supply systems for supplying water in its communities (RSA DWS, 2016). The four (4) water supply systems are: the Wilge Water Supply System and the source of water is the Wilge River Sterkfontein Water Supply System and the source of water is the Sterkfontein dam; Fika Patso Water Supply System and source of water is the Fika Patso dam; and the Makwane Water Supply System and the source of water is the Metsimatso dam.

According to DWS (2016), the Fika Patso water supply system is responsible for supplying water to 80% of the people living in Qwaqwa, of which 20% is supplied by the Makwane and Sterkfontein water supply system (RSA DWS, 2016). During the 2015-2016 drought, the Fika Patso dam was seriously affected and drastic water supply problems were experienced. Fika-Patso dam was at fifteen (15) percent; Metsimatso at seventy-five (75) percent; and Sterkfontein at eighty-seven (87) percent (RSA DWS, 2016). The majority of villages were affected by drought, due to the Fika-Patso dam being very low.

## **2.6 UNDERSTANDING THE CONCEPT OF DROUGHT IN THE STUDY**

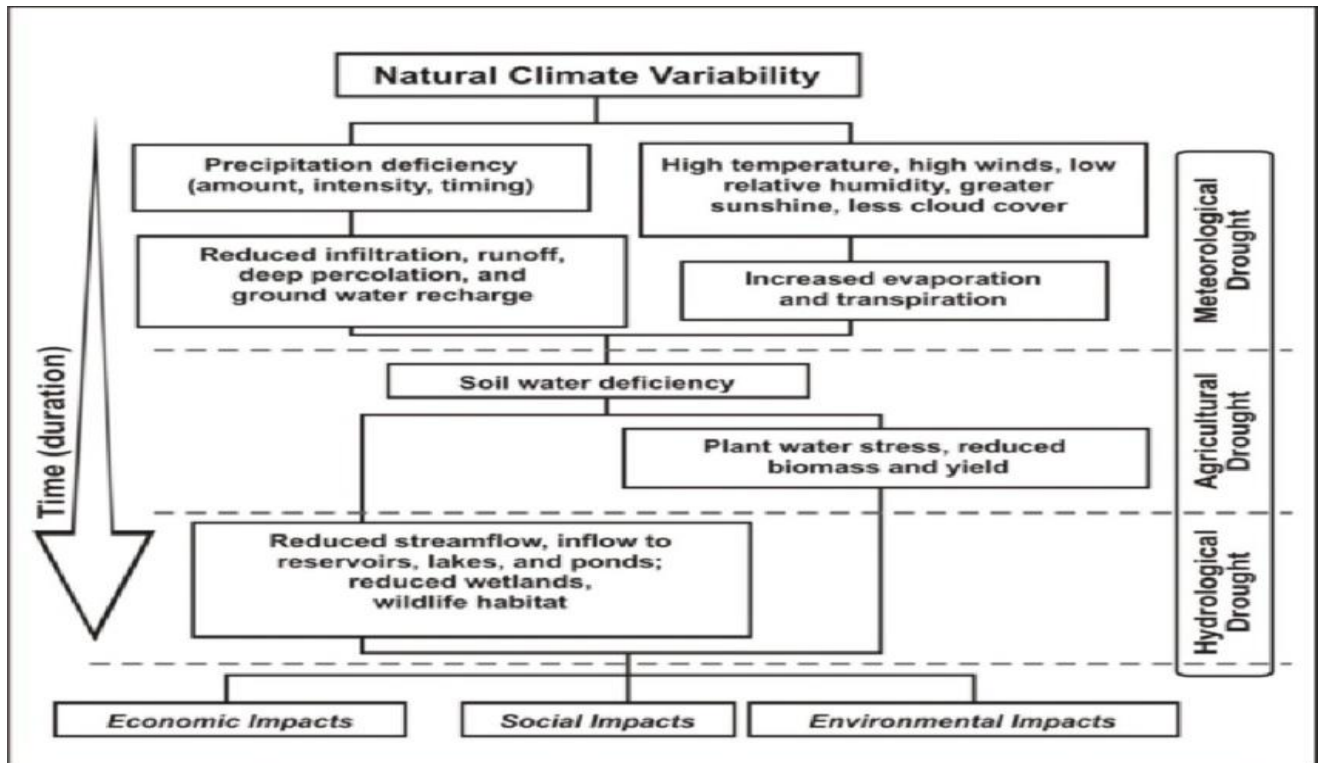
Even though it seems difficult to define drought, the literature review provides a number of definitions. There are two groups of academics that define drought. The first group focuses on the actual amount of rainfall. Wilhite and Buchanan-Smith (2005), define drought as a natural hazard that is caused by a lack of precipitation, when normal precipitation is expected. It is also a natural and global phenomenon that occurs when

the rivers and dam levels are very low (Tabari, Nikbakht, & Talaei, 2013). The extent of a period where a lack of rain is experienced longer than a season, eventually causes a lack of water resources to meet community water demand (Wilhite & Buchanan-Smith, 2005).

The second group defines drought by focusing on the temporal aspect of drought. Drought is believed to be an episode of normal recurrent features of climate change (Glantz, Betsill, & Crandall, 1997). According to Wilhite (2000), drought is a temporary, abnormal situation within a normal climate. Drought is mostly caused by climate change in South Africa (The Water Wheel, 2016).

Duan and Mei (2014) have categorised drought into three types, namely: meteorological, agricultural, and hydrological drought. This research focuses on hydrological drought only due to water challenges faced in QwaQwa and one of the main dam had low water levels. All drought types originate from a lack of precipitation, high temperature, and winds. Meteorological drought is regarded to be caused mostly by lack of rainfall (Duan & Mei, 2014). Owing to a lack of rainfall, evaporation and transmission will increase, leading to soil water deficiency. When the soil lacks moisture, the vegetation becomes water stressed and drought escalates to the stage of agricultural drought. A consistent lack of rain for a long period will cause rivers, streams, lakes, and ponds to become dry and drought will intensify to hydrological drought. All drought types will eventually affect the economy, social life, and environment. Figure 2.1 below is a schematic representation of the three types of drought cascades.





Source: Adapted from NDMC (2000).

**Figure 2.1: Natural climate variability over time and the impacts of the three drought types on economy, social and environment.**

## 2.6.1 Types of drought

There are several types of drought that can affect a community and the country at large. As indicated previously, the three types of drought are namely: meteorological, agricultural and hydrological drought. Although the study is particularly focused on hydrological drought, it is important to understand the different types of drought and their linkages.

### 2.6.1.1 Meteorological drought

Palmer (1965) defines meteorological drought as the extent of dryness and the duration of the dry period. Meteorological drought is considered to be very specific to certain regions due atmospheric conditions. Other definitions of meteorological drought consider the number of days of precipitation as their basis of measurement. This measurement is

mostly appropriate in the regions that are characterised by year-round precipitation. According to the South African rainfall patterns, the country does not have all year-round precipitation, compared to countries, such as Manaus, Brazil (Crétat, Richard, Pohl, Rouault, Reason, & Fauchereau, 2012). Most areas in South Africa receive rainfall during summer.

### **2.6.1.2 Agricultural drought**

Agriculture plays an important role in the economy of South Africa (Machethe, 2004). Agricultural drought is mostly defined by the extent of the deficiency in soil moisture which affects crop development. The soil moisture drops to a level wherein normal crop growth and development are compromised and affects crop yield (Todisco, Vergni, Mannocchi, & Bomba, 2012).

### **2.6.1.3 Hydrological drought**

Hydrological drought refers to a lack of water resources in the catchment area, resulting in low flowing levels in the rivers, extremely low levels of groundwater table (Van Loon, 2015). A prolonged meteorological drought may in result into hydrological drought, which occurs over long time scales of 24 to 48 months whereby both surface water and groundwater levels get affected negatively (Sheffield, Goteti, Wen, & Wood, 2004).

Despite hydrological drought being caused by the reduction of surface and sub-surface water, there is a serious demand around water resources by many sectors, such as agriculture, communities, hydropower and other industries, which create competition for the water resources (Bijl, Bogaart, Kram, de Vries, & van Vuuren, 2016). In most cases, competition for water resources may increase during drought, and conflicts between water users may rise significantly.

## 2.6.2 Impact of hydrological drought

It is pivotal to understand impact of hydrological drought for one to be able to manage hydrological drought. When drought is not managed properly, it negatively impact on socio-economics and environment can be expected, which in turn affect the livelihoods of communities (Van Loon, Ploum, Parajka, Fleig, Garnier, Laaha, & Van Lanen, 2015). These livelihoods are mostly dependent on the water availability for the communities and household incomes (Calow, MacDonald, Nicol, Robins, & Kebede, 2006).

The availability of water is very important to the economy, society and environment (Tsakiris, 2016). With this in mind, the Food and Agriculture Organization (FAO) (2013), has outlined drought as having two types of impact (direct and indirect impact). The impacts are tabled as follows:

**Table 2.1: Direct and indirect impacts of drought**

Impacts of drought	
Direct impacts	Indirect impacts
Reduced forests and lack crop productivity	Reduced income in the agricultural sector
Low water levels	Reduced food production and farming
Increased fire hazard	Cost of food being high
High mortality of wildlife and livestock	Increased unemployment, specifically for people who work at the car washes due to restrictions imposed on water use.

Source: FAO (2013)

As per impacts of drought presented above, it is clear that drought has significant impacts towards development, environment and the well-being of people if not properly managed.

### 2.6.2.1 *Economic impacts*

The greatest impact of drought is felt by the economic sector that is entirely dependent on water resources for the businesses to operate efficiently. The agricultural sector is mostly affected (Folger, Cody, & Carter, 2012). The economic impact of drought can lead

to severe income losses and a member of a community may lose their agricultural activities, such as livestock and crop production. A lack of, or reduced income can lead to unemployment among farmworkers and a capital shortfall for farmers which might affect their credit ability to sustain their business (Wilhite & Glantz, 1985). Furthermore, this might cause food production to be expensive which will eventually lead to food prices increasing significantly due to a reduced supply.

#### **2.6.2.2 Social impacts**

Drought has a huge number of severe social impacts on our communities (Vogel & van Zyl, 2016). These impacts can negatively affect the health and safety of our communities. Furthermore, drought is known to affect the quality of life, increase food insecurity and cause conflict over water (Shoroma, 2014). Food insecurity can cause the loss of human life and during times of drought the situation can be more severe (Gould & Nissen-Petersen, 1999). Gould and Nissen-Petersen (1999) further indicate that the unequal distribution of drought aid relief in communities can have a social impact.

#### **2.6.3 Hydrological drought management perspective of the study**

Good governance on water resources can improve the management of hydrological drought and this talks to development of drought strategies and policies, while water resource management addresses hydrological drought mitigation plans (Tallaksen & Van Lanen, 2004). According to Sivakuma and Wilhite (2002) drought management consists of three components that assist one to properly plan for drought. The components are monitoring and early warning; risk and impact assessment; and mitigation responses.

##### **2.6.3.1 Monitoring and early warning**

The ultimate objective of drought monitoring is to a well-informed information that enables and allows communities and organisations to plan properly, in attempt to minimise the impact of drought and the potential damage to crops and other assets (Quiring, 2009).

According to Baudoin *et al* (2017), it is widely agreed that for one to properly mitigate drought impacts is through preparedness and response, and having effective early warning system.

In South Africa information regarding weather, seasonal and even climate forecasts are available within government. This climate information is produced, disseminated and communicated through various channels where is available for public use.

Water Services Authorities should find it important to know and understand their water resources, to plan for drought properly. According to the Water Services Act (No 108 of 1997), Water Services Authorities are given a responsibility to ensure the right to basic water supply. For the municipalities to be able to meet this mandate, they need to have information about their water resources and be timeously updated.

In South Africa DWS normally is the one department that manages hydrological services and national water resource management (Mosley, 2001). This is creating a huge gap where the municipalities are not able to perform hydrological services. Municipalities are not effectively managing their water resources, even though some are recognised as water services authorities. In many other countries, municipalities are seen to be managing their water resources effectively. According to Kenney, Klein, and Clark (2004) Colorados' Front Range Municipalities in America, are managing their local water resources effectively and contributing to the effective management of the water demand during the drought period.

### **2.6.3.2 Risk and impact assessment**

Drought can produce a complex web of impacts which affect many sectors of the economy. The risk of a community being exposed to drought and social vulnerability should be understood, assessed accordingly and planned properly. In order to reduce these vulnerabilities, it is important understand the underlying causes of drought. According to Sivakumar and Wilhite (2002), information on a drought's impact and its causes is crucial for reducing drought risk before it happens and for putting in place the appropriate responses during drought. Furthermore, it is important to have a risk

assessments committee that will be responsible for assessing risks and coming up with reasonable mitigation measures.

#### **2.6.4 Mitigation plans and response**

Management of drought is a continues challenge in both developing and developed nations (Cai, Zeng, Kang, Song, & Valocchi, 2015). According to Gupta, Tykai, & Sehgal (2011), drought management include early warning systems, mitigations plans and monitoring. Proper planning and implementation of the plans is fundamental for water resource management (Hamdy and Trisorio-Liuzzi, 2008). However, most of drought mitigation and practices are often implemented too late to be effective (Gupta *et al.*, 2011)

##### ***2.6.4.1 Operational interventions applied by municipalities in response to hydrological drought***

Drought forces Water Services Authorities to find alternatives ways to improve provision water to its communities evening though there is limited water resources (Lottering, Du Plessis, & Donaldson, 2015). They are forced to develop policies and strategies that will allow them to operate during drought.

Water restrictions approach is seen as one of the most effective approaches to counteract drought (Kenney *et al.*, 2004). The approach is normally implemented in two phases, where normal restrictions and mandatory restrictions are used. Normal restrictions are restrictions which are not gazetted, while mandatory restrictions are restrictions that are nationally gazetted (Kenney *et al.*, 2004).

Lastly, groundwater and water tankers are some of the interventions done by municipalities. Groundwater has been seen as alternative use to a surface water deficit (Afrika, 2017). However, it is important to properly manage groundwater as it run the rist of being exploited and threaten the reliability for water supply (Castle,Thomas, Reager, Rodell, Swenson, & Famiglietti, 2014). Conjunctive use of surface water and groundwater

can improve the management of water resources during drought (Srinivasan, Seto, Emerson, & Gorelick, 2013).

#### **2.6.4.2 *Communities' coping strategies for hydrological drought***

Community members tend to develop drought coping strategies during drought in order to for them to continue maintaining their livelihood activities. These coping strategies are referred as coping skills that help communities to be able to deal with drought (Shoroma, 2014). These drought coping strategies include small-scale business, job hunting, food hunting, and other related strategies (Vilane, Manyatsi, & Shabangu, 2015). Job hunting for getting cash income is the most common alternative strategy (Yaffa, 2013). Groundwater is also used as an alternative water source for households (Shah, 2013).

#### **2.6.5 Drought policy and strategies in South Africa**

According to Shoroma (2014), countries experiencing drought have developed policies and legislative frameworks to be the focal point to ensure proper mitigation of drought. These policies and legislative frameworks guide how people should use their capabilities to cope during drought (Adato & Meinzen-Dick, 2002). As a result, it is important for countries to understand their policies and strategies that are available to minimise the effects of drought (Wilhite, Sivakumar, & Pulwarty, 2014).

The Constitution of South Africa, the promulgation of the Disaster Management Act No.57 of 2002, and the National Disaster Risk Management Framework of 2005 all include disaster strategies but we are still failing to deal with drought effectively (Meissner & Jacobs-Mata, 2016). These acts and policies provide guidance for mitigating the severity of drought, emergency preparedness, rapid and effective response to drought and post-drought recovery. The acts further give provision for establishment of national, provincial, and municipal disaster management strategies.

### **2.6.5.1 *The Constitution of the Republic of South Africa, 1996***

According to this constitution (1996), the three spheres of government are obliged to secure the well-being of the people of South Africa. The constitution further mandate all spheres of government to work together in ensuring service delivery to the people. National and provincial government are mandate to capacitate and support municipalities to meet its own mandate.

### **2.6.5.2 *Disaster Management Act of 57 of 2002***

The act aims to provide an integrated and coordinated disaster management policy that focuses on the prevention or reduction of the risk of disasters; mitigating their severity; emergency preparedness; the rapid and effective response to disasters; and post-disaster recovery. Furthermore, further require district municipalities to establish disaster management centres that are effective and efficient to manage disasters in the local municipalities.

### **2.6.5.3 *National Disaster Risk Management Framework of South Africa 2005***

After the promulgation of the Disaster Management Act 57 of 2002, the South African government established a framework for disaster management in 2005. This tool was then named the National Disaster Risk Management Framework (NDMF). Its aim is to provide a coherent, transparent and inclusive policy on disaster management that will be appropriate for all South Africans.

The NDMF is structured into four Key Performance Areas (KPA) and three Enablers (Van Zyl, 2006). These KPAs are tools to assist in managing disasters, while Enablers assist in reducing the vulnerability of communities during a disaster. The four KPAs and Enablers are indicated below.

#### **Key Performance Areas**

- Integrate institutional capacity for disaster management



- Conduct risk assessment during a disaster
- Reduction of risk disaster
- Response and recovery

### **Enablers**

- Communication and information management
- Training, education, public awareness and research
- Funding arrangement for disaster risk management

Drought management is the responsibility of all spheres of South Africa society. The drought management plan outlines that jointly government, communities, farmers' associations, private organisations and society at large should work together in dealing with disasters.

## **2.7 CONCLUSION**

This chapter outlined the theoretical background of people centred development and water resources challenges including the types of drought and their impacts on sustainable livelihoods of the communities. It also described the intervention required to manage the hydrological drought properly. Furthermore, mitigation plans and responses towards are outlined to understand properly what is needed to do when municipalities want to plan for drought management. Drought policies and strategies were further discussed to share knowledge on the legislation to be followed when dealing with drought since it affects all stakeholders in the municipalities.

## **CHAPTER 3**

### **RESEARCH METHODOLOGY**

#### **3.1 INTRODUCTION**

This chapter focuses on the methodology and strategies used to carry out the study. According to Kothari (2004), methodology includes procedures, the application of techniques, and the method of analysis. This section describes the research design and methodologies that were used in this study in order to obtain the aim and objectives of the study. This section consists of the research design; study area; data collection strategy; sampling design; research ethics; limitation of the study; data analysis; and the data measurement map.

#### **3.2 RESEARCH DESIGN**

Research design is guideline or plan to implement a research project (Maxwell, 2012). It shows how the research was developed and conducted (Given, 2008). Selecting a good research design should be informed by whether the design can provide the best and relevant answers to the research questions (Kumar, 2011). There are three types research approaches that direct and give specific ways of conducting research, which are mixed, qualitative, and quantitative approach (Creswell, 2013). A mixed method research was used to explore the impacts of hydrological drought management on sustainable livelihoods in the Qwaqwa community.

The mixed method research approach was employed in order to achieve the research objectives of the study. The collection of data was done in two ways, which involved gathering numeric information, as well as text information to have a database representing both qualitative and quantitative information.

The research employed a combination of the qualitative and quantitative approaches in order to exhaust all possibilities and views of the community members of Qwaqwa and the management of Maluti-a-Phofung Local Municipality. This method helps to reduce

shortfalls when collecting data, due to the employment of various methods, compared to using one method (Cronholm & Hjalmarsson, 2011). According to Creswell (2013), a case study approach works hand-in-hand with the mixed method approach and provides in-depth information about the area of study, which in this case, is Qwaqwa. Johnson and Onwuegbuzie (2004) further emphasise that the mixed method approach is advantageous because it puts together techniques, methods and concepts used in both the quantitative and qualitative approaches to assist the researcher to garner more data that represent the study area.

The qualitative approach is an in-depth study that involves a naturalistic and interpretive approach to its subject matter (Given, 2008). Qualitative approach was followed to get a deep understanding of how municipal employees at management level managed hydrological drought.

The quantitative approach is defined as social research, which uses empirical techniques and empirical propositions to acquire data (Creswell, 2013). The collection of data can be through a survey questionnaire in a numerical format. The quantitative approach helped more in understanding how households are affected by hydrological drought. It further helped in understanding how the municipality managed drought.

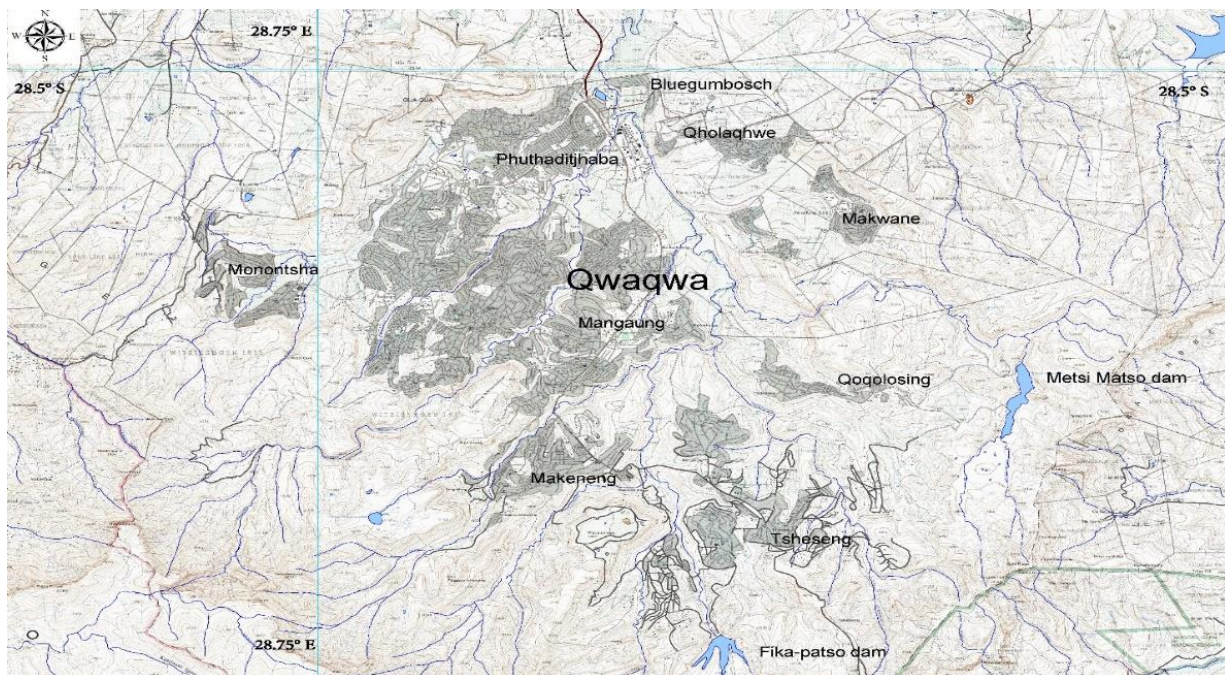
### **3.2.1 Case study research design**

According to Meriam (1998), a case study is an intensive description and analysis of a single instance, phenomenon or social unit. The case study approach helps the researcher to examine primary data within the environment activity is taking place (Yin, 1994). Although there are some criticisms of case study design, it remains the appropriate design for mixed approach research because of its flexibility (Murphy, 2014). Therefore, this study focused on the Maluti-a-Phofung Local Municipality in the Qwaqwa community, with specific reference to seven (7) rural villages: Jwala Boholo; Qoqolosing; Thaba Bosiu; Tseki; Monotsha; Bolata; and Namahadi (Statistics South Africa, 2011). This case study research design established an in-depth understanding of the impact of hydrological

drought management on sustainable livelihoods in the sampled seven (7) rural villages of Qwaqwa.

### 3.2.2 Study area

The study area is Qwaqwa in the Maluti-a-Phofung Local Municipality, Free State Province of South Africa.



**Figure 3.1: Layout of QwaQwa area**

The municipality has three main areas that are Harrismith, Kestel and Qwaqwa. The head office of the municipality is in Qwaqwa. The municipality has a water entity called Maluti-a-Phofung Water. The entity deals with the operation and maintenance of the water and sanitation infrastructure of the municipality.

Qwaqwa is the one of the smallest former homelands of South Africa in relation to land area and population (Koatla, 2012). It is now the home of the Basotho people and falls under the Maluti-a-Phofung Local Municipality. Qwaqwa is between the latitude 28.5' south of the Equator and longitude 28.75' east. The temperate climate that falls within the summer rainfall zone of South Africa. The rainfall ranges from 400mm to greater than 1

000mm with temperatures ranging from 10.75°C to more than 25°C (RSA DWS, 2016) on a yearly average.

The area of Qwaqwa has about sixty-four (64) villages with a population of 273 759 (Statistics South Africa, 2011). Land use type is mainly residential, agricultural and natural vegetation (Aliber, Greenberg, Eveleth, Kleinbooi, Lahiff, & Tom, 2006). These villages depend on different water sources, namely the Fika-Patso, Metsimatso, and Sterkfontein dams. The majority of the villages depend on the Fika-Patso dam as a source of water supply (RSA DWS, 2016).

Many of the villages were affected by drought due to the Fika-Patso dam being low. However, seven (7) villages that are Jwala Boholo; Qoqolosing; Thaba Bosiu; Tseki; Monotsha; Bolata; and Namahadi were highlighted as mostly affected during the drought because they do not have functioning boreholes, in addition to the low Fika-Patso dam (RSA DWS, 2016). This study focused on these worst affected villages to understand the negative impact of the drought, exacerbated by poor governance and management, low dam levels, and the absence of functioning boreholes in the Maluti-a-Phofung Local Municipality.

### **3.3 DATA COLLECTION STRATEGY**

Primary data in this study were collected by administering interviews and a survey questionnaire. Field notes were gathered by administering an interview guide with the management team of the Maluti-a-Phofung Local Municipality working in the Qwaqwa offices.

In the first instance, survey questionnaires were used to collect data from the municipal officials who are responsible operation and maintenance of the water and sanitation infrastructure of the Maluti-a-Phofung Local Municipality in Qwaqwa. In the second instance, survey questionnaires were utilised to collect data from the residents of the seven villages that were the worst affected by the drought. The survey questionnaires were in two languages namely Sesotho and English in order to accommodate village community members and government officials. The survey questionnaires were less

expensive, confidential, and offered greater anonymity. The respondents were selected by the researcher while the collection of data was done by the researcher with the assistance of two enumerators.

Permission to interview and conduct a survey with the key informants was requested from the Administrator of the municipality. Pre-appointments were done with the thirty-eight (38) municipal officials, emails and cell phone contacts to check their availability, so as to avoid disrupting their working schedules. A councilor was allocated by the Administrator to assist the researcher in conducting research at community level. The households (hundred-and-ten - 110) were contacted and requested permission to conduct the research. The study targeted the heads of these households because they are responsible for household activities and would be able to give information on the usage of water in their households. The study was undertaken during the week and at weekends to increase the chances of communicating with the respondents.

### **3.3.1 Municipal officials at management level**

Interview technique is advantageous and enable the researcher to obtain more information and accurate answers from the respondents (Wimmer and Dominick, 2006).

The researcher employed a structured interview to obtain a dataset from municipal officials at management level. The municipal officials at management level were from the Maluti-a-Phofung Local Municipality in these positions of authority: Administrator; Acting Municipal manager; Technical director; Disaster management; the Maluti-a-Phofung Water Entity's Chief executive officer; Operation manager; Water operation manager, and manager for water and sanitation operations. The telephonic interviews were arranged with these key informants due to COVID 19 regulations.

Maluti-a-Phofung Water Entity was chosen on the basis that they would assist the researcher in understanding how the municipality manages its water resources and management decisions that were taken during drought period. Furthermore, they assisted the researcher in understanding how the municipality managed hydrological drought.

### **3.3.2 Non-management municipal officials**

A survey questionnaire with closed-ended questions was used to collect primary data from the Maluti-a-Phofung Water Entity employees who were working with the operation and maintenance of water systems at the municipality.

The officials from the Maluti-a-Phofung Water Entity assisted the researcher in understanding how they run the operations and the maintenance of water infrastructure during drought. They also assisted in obtaining clarity on how hydrological drought was managed. Furthermore, the survey questionnaires were classified accordingly, for the municipal officials who were not at management level.

### **3.3.3 Community members**

A survey questionnaire for community members was developed for them to complete. Seven (7) villages in Qwaqwa were chosen on the basis that they would assist the researcher to understand the impact of hydrological drought management on their sustainable livelihoods and their coping strategies during a drought.

According to the Integrated Development Plan (IDP, 2018/19) of the Maluti-a-Phofung Local Municipality, the majority of Qwaqwa residents are Sesotho speaking people. The researcher is a Sepedi speaking person and understands the Sesotho language. Two enumerators who were local helped the researcher to administer the survey questionnaires during data collection. Furthermore, the survey questionnaires were in Sesotho and English to accommodate the community members.

## **3.4 SAMPLING DESIGN**

The study used purposive sampling due its being a mixed methods study. The study used purposive sampling for selecting management and non-management officials of the

Maluti-a-Phofung Local Municipality in Qwaqwa. A purposive sampling technique was also used to select participants in the seven (7) villages of Qwaqwa.

Purposive sampling is a non-probability sampling whereby the researcher uses their own judgement to choose key informants to participate in the research study (Creswell, 2013). It is mostly associated with small and in-depth studies.

### **3.4.1 Municipal officials at Management level**

The researcher used purposive sampling to select eight (8) key respondents in the Maluti-a-Phofung Local Municipality in Qwaqwa. These selected key respondents were: the Administrator; Acting Municipal manager; Technical director; Disaster management; the Maluti-a-Phofung Water Entity's Chief executive officer; Operation manager; Water operation manager; and the manager for water and sanitation operations. The officials were contacted through the permission of the Administrator of the municipality.

### **3.4.2 Non-management municipal officials**

According to the Integrated Development Plan (IDP, 2018/19), Maluti-a-Phofung Water Entity has three-hundred-and-fourteen (314) employees, mostly working directly with the operation and maintenance of water and sanitation infrastructure. The researcher conducted a survey (9.5%) of the 314 employees to get a preliminary understanding of how they run their operations during drought. The researcher used a purposive sampling to select thirty (30) key informants from the Maluti-a-Phofung Water Entity who are non-managers to complete the survey questionnaire.

The thirty (30) non-managerial officials from the municipality helped the researcher to get a preliminary understanding of how they run the operations and maintenance of water infrastructure during drought, thereby assisting in a better understanding of hydrological drought management from their perspective. The officials were contacted through the permission of the Administrator of the municipality. The officials were contacted based on their availability.



### 3.4.3 Community members

The researcher used purposive sampling to select community members of Qwaqwa to participate in the research. Qwaqwa has sixty-four (64) villages with a population of 273, 759 and a household number of 82, 444. The study focused on seven (7) villages that were dependent on water supply from the Fika Dam that failed during the drought (DWS, 2016). The seven (7) villages Jwala Boholo; Qoqolosing; Thaba Bosiu; Tseki; Monotsha; Bolata; and Namahadiand had a combined number of 10, 564 households and a population of 36, 182 (Statistics South Africa, 2011). A sample of one-hundred-and-ten (110) participants was selected from a population of around 36, 182.

The sample size targeted was a small portion of the total set of the population of the seven (7) villages in Qwaqwa. The aim was to get information on how the community was affected during the hydrological drought and their coping response towards hydrological drought. The study considered adults aged eighteen (18) years and older from all race groups and gender. One person was surveyed per household. The study targeted the heads of the households.

**Table 3.1: Study sample size groupings**

<b>Sector</b>	<b>Sample number</b>
Managers of Maluti-a-Phofung Local Municipality and Maluti-a-Phofung Water Entity	8
Non-management employees of Maluti-a-Phofung Local Municipality and Maluti-a-Phofung Water Entity	30
Community members in Qwaqwa, specific to seven villages	110
Total sample size	148

### **3.5 RESEARCH ETHICS**

Ethics are principles that a researcher should adhere to when conducting research for the study to have meaningful outcomes (Creswell, 2013). The ethical behaviour of the researchers is of utmost importance in scientific research.

#### **3.5.1 Limiting Bias**

As mentioned earlier, the researcher standardised the data collection methods and data collection tools in order to limit bias when gathering field notes and collecting primary data. Leading questions were avoided to reduce the limitations on respondents expressing their views freely.

#### **3.5.2 Negotiating gate keepers**

Permission to conduct the research at the municipality was solicited from the Administrator of the Maluti-a-Phofung Local Municipality to make all employees feel free to participate in the study.

#### **3.5.3 Informed Consent**

The researcher explained in detail the purpose of the research, problem statement, research objectives, and research aims to the employees of the Maluti-a-Phofung Local Municipality, the Maluti-a-Phofung Water Entity, and the local community respondents to obtain their informed consent. Each participant had to sign a consent form before participating in the research.

#### **3.5.4 Privacy and Confidentiality**

The confidentiality of the respondents was and will not be compromised, even after the completion of the research. According to Marshall and Rossman (2014), privacy and

confidentiality should be upheld as enshrined in the Data Protection Act of 1988. During interviews, participants were not allowed to provide their names but labelled as employees of the sectors (i.e. employee 1 for respondent 1). Respondents were provided with the opportunity to suggest the procedure which they felt most comfortable when being interviewed. The respondents were provided with a consent form to participate freely or to withdraw if they wished to. Furthermore, the researcher explained the research to the participants and what the study sought to achieve.

### **3.5.5 Data protection**

A further step to ensure confidentiality and privacy is data protection. Thus, the responses from the interviews and survey questionnaires are kept under lock and key in a plastic box sealed with cable ties. This box was kept in close proximity to the principal researcher when transporting it from the research site to the office for data analysis and interpretation. The principal researcher does not share an office space with any colleague. This empowers the principal researcher to keep his office under lock and key and to ensure the safety of the field notes and the primary data.

### **3.5.6 Right to withdraw**

All the respondents were informed about their right to withdraw at any stage or time of the study without giving reasons to the principal researcher.

### **3.5.7 Conflict of interests and limiting researcher's bias**

The researcher rightly acknowledged the conflict of interests occasioned by being a principal researcher in a study that addresses sensitive issues in his area of employment. By interviewing his colleagues, although they work in different government departments and at different government levels (i.e. national government versus local government), it might have been seen as bias.

In view of this, the researcher did not completely separate his ideas on how drought ought to be managed. He acknowledged his bias in this regard and employed stringent research techniques, following them to the letter in order to limit, but not eliminate his bias occasioned by the conflict of interests.

Furthermore, the principal researcher works for DWS, which is directly affected by the study. The DWS was not sponsoring the research and it was conducted for academic purposes only.

### 3.5.8 Managing expectations of vulnerable stakeholders

The study unavoidably had to deal with broader socio-economic issues in the context of service delivery at Qwaqwa. The community of Qwaqwa was vulnerable, since the issue of basic water service provision was a serious matter in the community. It was important that the researcher was sensitively aware when facing the community during data collection and refrained from making unwarranted promises to vulnerable community members.

## 3.6 MEASURING MAP

**Table 3.2: Measuring Map**

Objective	Construct	Variable	Data source	Data/Question	Data analysis
Assess the effect of hydrological drought management on sustainable livelihoods in the	Hydrological drought management	Water levels	Interview with municipality	What were the water levels during drought?	Critical event analysis
		Monitoring of dams	Interview with municipality	How is the municipality monitoring its dams?	Thematic analysis

community of Qwaqwa		Equipment	Survey questionnaire and Interview with municipality	What equipment was the municipality using for measuring water levels and plotting systems?	Thematic analysis
	Effects of drought	Basic water supply	Survey questionnaire with the households	How did drought affect water supply and your in-house activities?	Critical event analysis
Define and assess the municipality managed to intervene to reduce drought effect.	Interventions on drought	Water restrictions	Interview and survey questionnaire with the municipality	Did the municipality implement water restrictions?	Critical event analysis
		Alternative water supply	Survey questionnaire with the municipality and households	What type of support was provided for water supply?	Critical event analysis

Community empowerment to overcome the effects of drought	Community engagement	Community Awareness	Survey questionnaire distributed to the municipality and households	How did the municipality inform the community about hydrological drought?	Critical event analysis  Critical event analysis
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**3.7 DATA ANALYSIS**

Data analysis is a process of explaining, understanding, or interpreting data (Creswell, 2013). In this regard, the research will interpret and analyse the field notes and primary data collected during the study. The field notes emanating from the qualitative interviews was analysed through thematic analysis, and descriptive analysis was used analyse quantitative data emanating from the survey questionnaire.

**3.7.1 Thematic Analysis of Field Notes**

Thematic analysis is a scientific tool for analysing communication messages. Clarke and Braun (2014) indicate that it identifies, analyses and reports the data in a pattern. Accordiing to Clarke and Braun (2014), thematic analysis is advantageous because is it flexible and is a widely used qualitative analytic method. The use of thematic analysis was more advantageous to the study. The method allows the researcher to code and interpret data according to different themes as they emerge from responses, as well as transcribe the interviews. Transcriptional coding was used for reporting data collected from interviews.

Coding is a way of arranging and sorting the data that is collected (Rubin & Babbie, 2010). It provided an opportunity to summarise what is happening in the data. The researcher summarised the data through the coding method. There are three types of coding that the researcher used for data analysis in this study. The coding included open coding; axial coding; and selective coding (Rubin & Babbie, 2010).

Before analysing the data, the researcher conducted pre-coding in which manual coding is used, such as markers, writing notes, and identifying terminologies. The researcher also employed both the deductive and inductive coding process. In addition, the researcher also used informal theories and the wisdom of practice.

### **3.7.2 Descriptive Analysis of Survey Questionnaire**

Descriptive analysis is a method to analyse data and it helps to describe and summarise data in a meaningful way, such that information is put into patterns. It describes the basic features of the data in the study and provides a knowledge base, which can be a foundation and ground for quantitative analysis by mapping the landscape of a specific phenomenon (Barnham, 2015). Furthermore, it describes variables, rather than testing the predicted relationship between variables. Through the use of descriptive analysis, a Statistical Package for the Social Sciences (SPSS) was used to process the data. SPSS was used to analyse, transform, and produce a characteristic pattern between different data variables. According to Arkkelin (2014), researchers often choose quantitative data analysis SPSS to achieve more understanding of the data that have been collected.

### **3.8 LIMITATION**

According to Simon and Goes (2013), limitations are constraints that may negatively affect the study or research and are beyond one's control. It is important for the researcher conducting study to be aware of its limitations and be able to minimise impact thereof.

According to DWS (2016), about seven municipalities were largely affected by drought in the Free State Province. However, this study was limited to Maluti-a-Phofung Local Municipality due to that it was highlighted as the municipality that was mostly affected by drought. Furthermore, because of the limited period of the study, choosing one municipality that was mostly affected helped the researcher to concentrate resources and gather more information about the impact of hydrological drought.

Maluti-a-Phofung Local Municipality has sixty-four (64) villages but the study focused only on seven (7) villages that were mostly affected by the drought.

Owing to the declaration of COVID 19, the time for the collection of data was prolonged and it was not easy to meet the respondents during the period of lockdown.

Lastly, the study depended on the availability of the key informants; thus, access was a limiting factor in the study. Eight (8) key informants were interviewed through phone calls.

### **3.9 CONCLUSION**

In conclusion, chapter three (3) presented a combination of methods used to collect data from the key informants in the study. The methods involved primary and secondary instruments which complemented each other. Interview questions and the survey questionnaire were adopted for the study to be able garner more information about the research. Data were analysed using both excel and statistical packages.



## **CHAPTER 4**

### **FINDINGS AND DISCUSSION**

#### **4.1 INTRODUCTION**

Chapter four (4) describes the findings and discussion of the study which are two-fold, as it sought to explore the municipal practices of hydrological drought management, and their effects on the sustainable livelihoods of the local communities in the Free State Province of South Africa. First, the findings shed light on the effects of droughts on local communities. Second, the findings highlight the management practices that were employed by the municipalities and other stakeholders in mitigating the negative effects of the drought in their area of jurisdiction. The findings also provide a better understanding of municipal preparedness and drought management practices at local government level.

The study presents the findings in sections, namely the biographical information of the respondents; the effects analysis of the hydrological drought on the respondents; the management of hydrological drought by the municipality, and the effects of drought on the community.

#### **4.2 BIOGRAPHICAL CHARACTERISTICS**

The demographic profile of the respondents is discussed in order to understand the characteristics of the sample in the survey group. The survey was conducted using two enumerators who were led by the researcher. A total of one hundred and forty eight (148) respondents were targeted, wherein one hundred forty (140) respondents were targeted for survey questions and 8 respondents for interviews questions.

##### **4.2.1 Gender category of the respondents in the study**

Table 4.1 shows the gender distribution of the respondents. The majority of the respondents were female, representing 60.8% of the sample. Males were in the minority,

representing 39.2% of the sample. The highest number of the respondents was from the community members with 74.3%, followed by the municipal officials (non-management level) with 20.3% respondents, and municipal officials (management level) with the lowest 5.4% of respondents. The community members had the highest number of females at 69.1% and males at 30.9%, while municipal officials at non-management level had 60% of male and 40% of female. Municipal officials at management level had 75% male and 25% female respondents.

**Table 4.1: Frequency distribution of gender in the study**

Respondents	Frequency	Percentage	Male	Female
Community members	110	74.3	34 (30.9%)	76 (69.1%)
Municipal officials (non-management level)	30	20.3	18 (60%)	12 (40%)
Municipal officials (management level)	8	5.4	6 (75%)	2 (25%)
Total	148	100%	58 (39.2%)	90 (60.8%)

#### **4.2.2 Age category of the respondents in the study**

Table 4.2 shows the age of the respondents in five categories. About 75.8% of the respondents were people of 31 years of age and above. The lowest age group ranges from 26 to 30 years of age. The majority of the respondents from the community members were from the category of 41-55 age group, while the minority were from the age group 26-30. The municipal officials (non-management level) shows that the majority of employees were at the age of between 31 and 55, while only a few were aged 56 and

above. The municipal officials (management level) show that the majority of the respondents were at the age of 41-55.

Age also plays a major role in the study, as it represents maturity in decision making. Mature people are a reliable source of information, since they have more experience of behaviour in their social and environmental milieu. Table 4.2 shows the age of the respondents in five categories. About 75.8% of the respondents were people of 31 years of age and above. The lowest age group ranges between 26-30 years.

**Table 4.2: Frequency distribution for age groups in the study**

Respondents	Frequency	Percent	Age 18-25	Age 26-30	Age 31-40	Age 41-55	Age 56 and above
Community member	110	74.3	11(10%)	10(9.1%)	22(20%)	38(34.5%)	29(26.4%)
Municipal officials( non-management level)	30	20.3			13(43.3%)	13(43.3%)	4(13.4%)
Municipal officials( management level)	8	5.4			2(25%)	4(50%)	2(25%)
Total	148	100%	11(7.4%)	10(6.8%)	37(25%)	55(37.2%)	35(23.6%)

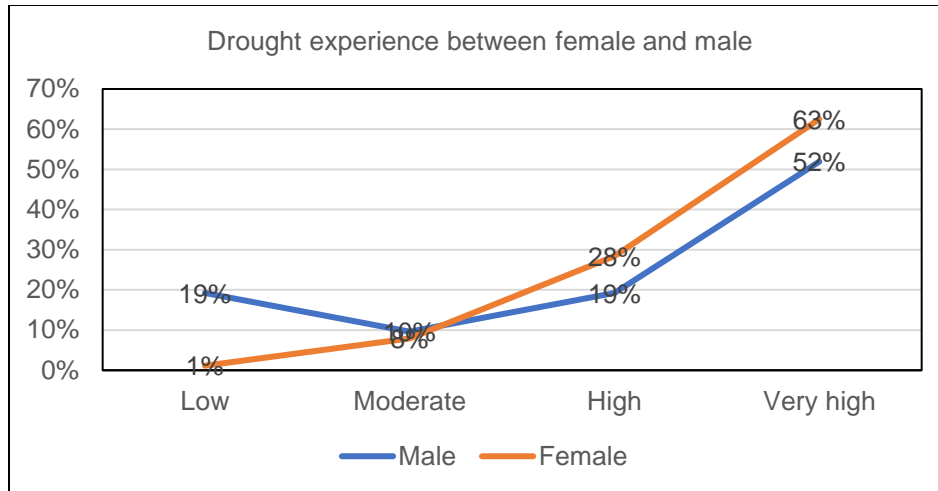
### **4.3 THE EFFECTS ANALYSIS OF THE DROUGHT ON THE RESPONDENTS IN THE STUDY**

According to Tsakiris (2016), the impacts of drought are mostly linked to water supply shortages at community level and in the society at large. However, the impact might vary from community to community, based on the available alternatives for access to water. The communities of Qwaqwa were severely affected by hydrological drought. According to the survey conducted, some households reported to have spent more than three months without the municipality delivering water to their areas. This situation led to households fetching water from naturally created wells. The study also shows that women were mostly affected by the drought situation.

#### **4.3.1 Gender based analysis on the experience of drought**

Figure 4.1 shows that females reported to have experienced drought the most as 63% indicated that they had experienced very high or severe drought. On the other hand, only 52% of males indicated that they had experienced very high drought.

Drought can have social consequences for women in developing countries (Keshavarz, Karami, & Vanclay, 2013). There is unequal power relations, gender inequality, and discrimination towards women and girls. They are often the one hit hardest during disasters and take longer to recover (Sultana, 2010). During drought, it is very difficult for women to access resources to be able to maintain their livelihoods activities. As a result, women and girls are more vulnerable to droughts and their ability to cope with the impacts of disasters cannot be undermined (Sultana, 2010). The understanding is that women perceive and experience drought differently compared to men. A question was posed to the respondents on how drought affected them and they had to rate it from low to very high.



**Figure 4.1: Understanding of drought between female and male**

Based on the effects of drought, the study further tested the hypothesis whereby the following assumptions were made:

- The drought intensity reflected as low implies that water was available during the drought.
- The drought intensity reflected as moderate implies that water was available but not always.
- The drought intensity reflected as high implies that water was not available but delivered through water trucks.
- The drought intensity reflected as very high implies that water was not available and supplied by water trucks only after a long time.

The hypothesis was done to check if the impact of drought would be different between the males and females according to their behavioural opinions (low, moderate, high, and very high) in the study. This was tested by using t-test statistics on the gender number and their responses to drought. The following hypotheses were tested:

- **Null Hypothesis:** There is no difference between females and males on the experience of drought effects in Qwaqwa.
- **Alternative Hypothesis:** There is a difference between females and males on the experience of drought effects in Qwaqwa.

#### 4.3.1.1 *Low rating about drought experience*

According to table 4.3  $p < 0.05$ , we therefore reject the null hypothesis. The proportions are significantly different at a confidence level of 0.05. We do not have enough evidence to support the alternative hypothesis.

**Table 4.3: Respondents for low rating**

Low rating drought experience		
	Proportion	Sample Size
Male	0,192308	52
Female	0,011364	88
p-value	0,0001	

#### 4.3.1.2 *Moderate rating about drought experience*

According to table 4.4  $p > 0.05$ , we therefore fail to reject the null hypothesis. The proportions are not significantly different at a confidence level of 0.05. We do not have enough evidence to support the alternative hypothesis.

**Table 4.4: Respondents for moderate rating**

Moderate rating of drought experience		
	Proportion	Sample Size
Male	0,096154	52
Female	0,079545	88
p-value	0,7345	

#### 4.3.1.3 *High rating about drought experience*

According to table 4.5  $p > 0.05$ , we therefore fail to reject the null hypothesis. The proportions are not significantly different at a confidence level of 0.05. We do not have enough evidence to support the alternative hypothesis.

**Table 4.5: Respondents for high rating**

High rating for drought experience		
	Proportion	Sample Size
Male	0,192308	52
Female	0,284091	88
p-value	0,2256	

**4.3.1.4 Very high rating about drought experience**

According to table 4.6  $p > 0.05$ , we therefore fail to reject the null hypothesis. The proportions are not significantly different at a confidence level of 0.05. We do not have enough evidence to support the alternative hypothesis.

**Table 4.6: Respondents for very high rating**

Very high rating for drought experience		
	Proportion	Sample Size
Male	0,519231	52
Female	0,625	88
p-value	0,2196	

Gender is one of the important aspects to consider during research. It appears that men and women see things differently and conditions affect them differently. In black rural society particularly, they are not equal in terms of societal and cultural beliefs; therefore, an analysis of their views was needed. According the findings, males and females experience drought differently.

### 4.3.2 Community members and municipal officials (non-management level) analysis on the experience of drought

Table 4.7 indicates the percentages of how hydrological drought affects the residents of Qwaqwa from the perspective of local community members and municipal officials. Most community members, about 63,64%, were very highly affected by drought, while only 19,09% were highly affected by it. On other hand, 40,00% of municipal officials said they were very highly affected by drought while 46,67% were highly affected.

**Table 4.7: Drought effects among Qwaqwa residents**

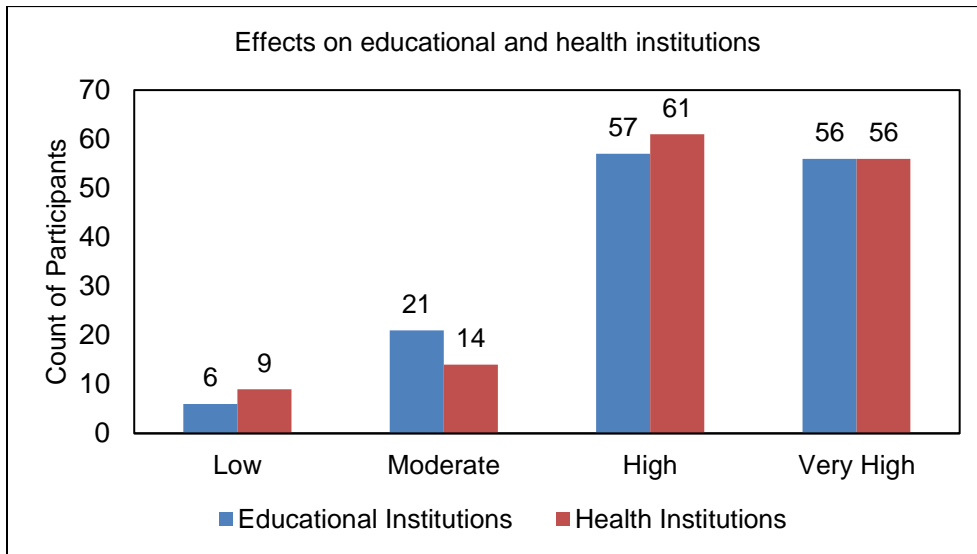
The effects of drought in Qwaqwa			
Drought Impact	Community member	Municipal officials	Total
Low	9,09%	3,33%	7,86%
Moderate	8,18%	10,00%	8,57%
High	19,09%	46,67%	25,00%
Very high	63,64%	40,00%	58,57%
Total	100,00%	100,00%	100,00%

Hydrological drought did not only affect households but also affected health and educational institutions. During the drought of 2016, some health institutions such as clinics and hospitals were threatening to close due to a lack of water. Vogel and van Zyl (2016) argues that drought has devastating effects on society at large, as it affects their productivity, culture, and livelihood activities. Figure 4.2 shows how educational and health institutions were affected by drought. In Figure 4.2, it can clearly be seen that educational and health institutions were mostly very highly and highly affected by the negative impact of the drought. In rural areas, children are likely to drop out of school as they move with their parents in search of water and pasture, because of the drought in their areas (Lekapana, 2013). This might have also been the case in the rural communities of the Qwaqwa area.

In addition, a lack of water in the health facilities can worsen the conditions of sick patients, leading to a deterioration in their health. It then follows that drought, depending



on its severity and duration, as well as the underlying factors of the population, such as vulnerability and access to resources, can have devastating effects on the affected populations' health outcomes (Barreau, Conway, Hought, Jackson, Kreutzer, Lockman, Minnick, Roisman, Rozell, Smorodinsky, & Tafoya, 2017).



**Figure 4.2: Drought effects on educational and health institutions**

#### **4.4 MANAGEMENT OF HYDROLOGICAL DROUGHT BY MALUTI-A-PHOFUNG LOCAL MUNICIPALITY**

The management of hydrological drought is very important to avoid unnecessary disaster. The Water Services Act No 108 of 1997 requires the Water Service Authority to provide basic water services to its consumers. When early-warning systems detect signals of a drought, the Water Service Authority should prepare drought management strategies and mitigation plans timeously to prevent or reduce the negative effects of the drought and implement interventions that will help to ensure proper water supply with acceptable water quality to all its consumers.

Furthermore, Disaster Management Act No 57 of 2002 makes provision for an integrated and coordinated approach when dealing with disaster management. It further emphasis on preventing or reducing the risk of disasters; mitigating the severity of disasters;

emergency preparedness; and rapid and effective response to disasters and post-disaster recovery.

#### **4.4.1 Municipal preparedness for hydrological drought**

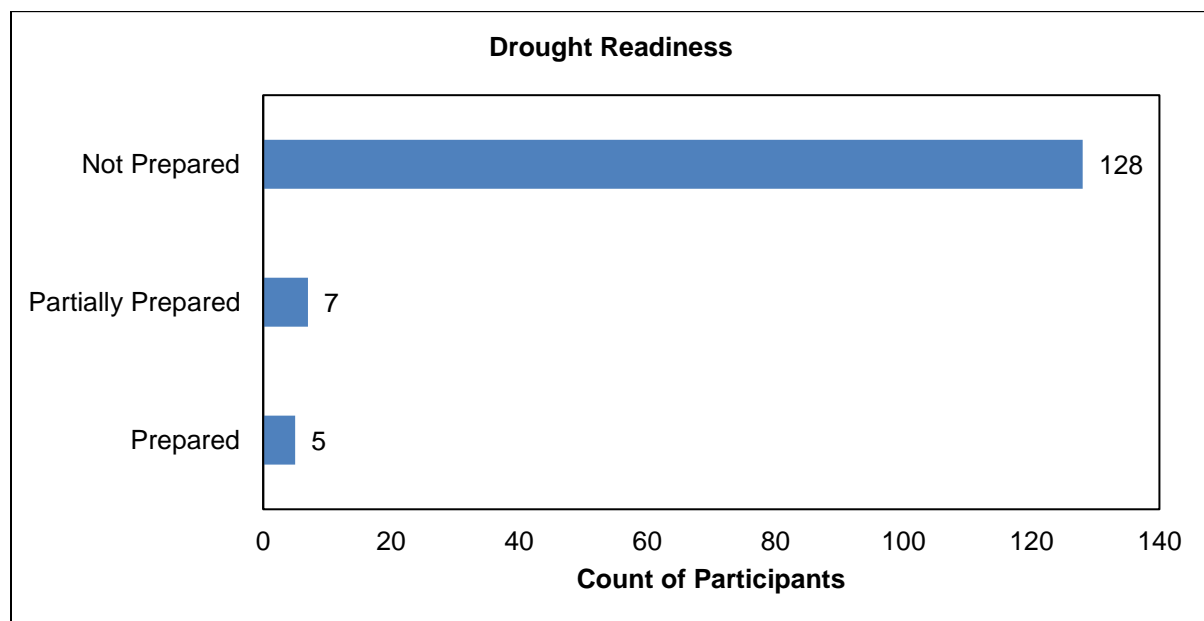
According to Figure 4.3, of one hundred forty (140) respondents (community members and municipal officials at non-management), one hundred and twenty-eight (128) respondents indicated that the municipality and the communities were not prepared for the hydrological drought. Seven (7) of the respondents indicated that the municipality was partially prepared for the drought, while only five (5) out of 140 respondents indicated that the municipality was prepared.

In addition, *Maluti-a-Phofung water* as the water entity of the municipality, did not have the requisite capacity to take dam levels readings in order to alert the municipality of the water resource depletion in Fika-Patso dam. During the interviews of eight (8) employees at management level, it was stressed that their entity does not have capacity to manage water resources and that they mostly relied on the Department of Water and Sanitation dam level readings. The management of water resources is more complex because of a huge number of users and conflicting interest (Pipitone, Maltese, Dardanelli, Lo Brutto, & La Loggia, 2018). It is important for the municipalities to monitor dam levels to be able to advise the municipal council accordingly on time.

Municipalities that are Water Service Authorities are mandated to prepare disaster management plans for their respective areas in accordance with the prevailing circumstances in their area in line with Section 53 of Disaster Management Act No 57 of 2002. Section 42 of the Disaster Management Act No 57 of 2002 further requires the district municipalities with local municipalities to establish and implement a framework for disaster management in the municipality, whereby disaster management centres are established. The disaster management centres are responsible for promoting a coordinated and integrated approach when managing drought in the municipal area. These centres also play an advisory role and recommend drought business plans to other organs of state for funding.

It is important for the municipalities to work with these disaster management centres to be able to prepare and better manage drought conditions. According Wilhite (2016), drought preparedness entails the development of resources and the capacity to prevent, protect against, respond to, recover from, and mitigate the negative effects of natural disasters. Drought management involves all levels of government, from the municipality to national level (Enqvist & Ziervogel, 2019). Forums are established to ensure that all stakeholders take part in the management of drought. If forums are not effective or taken seriously, the whole process of drought management is compromised or becomes one-sided and mostly on the technical side, as was seen in Maluti-a-Phofung LM. Water crises require broader societal responses than simply technical experts (Dilling, Daly, Kenney, Klein, Miller, Ray, Travis, & Wilhelmi, 2019). Managers in Water Service Authorities are required to develop actionable plans in order to build up the necessary capabilities and controls to prevent or reduce drought risks.

Figure 4.3 shows that Section 42 of Disaster Management Act No 57 of 2002 was never followed or adhered with regard to Maluti-a-Phofung LM drought, as the majority of the municipal respondents and the local community members answered that their municipality was not and had not prepared for a slow-onset event, that is the drought. Their answers are supported by the responses represented in Figure 4.3 below:



**Figure 4.3: Rating indicating municipal preparedness**

According to table 4.8, 53% of the respondents (municipal officials at non-management level), reported that the municipality did not develop a business plan for drought; 30% of the respondents indicated that a detailed business plan for drought was developed, while 17% of the respondents indicated that a business plan was developed but not detailed.

During the interviews of the municipal employees at management level, it was found that a drought business plan was developed but not detailed and was not fully funded, which aggravated the drought situation in the municipality.

**Table 4.8: Development of drought business plan by municipality**

Development of drought business plan		
	Count of Participants	Percentage
Not developed	16	53%
Developed but not detailed	5	17%
Comprehensive with budgets	9	30%
Total	30	100%

#### **4.4.2 Community empowerment regarding drought management**

Table 4.9 indicates that 83% of the respondents (municipal officials at non-management level) reported that the municipality did not conduct civic education for communities to learn more about drought and how to save water during drought. Only 17% of the respondents indicated that civic education was conducted. Furthermore, figure 4.4 indicates that five (5) of the respondents who reported that civic education was done, three (3) reported that the municipality provided the community with appropriate civic education, while two (2) respondents indicated that the civic education given was not appropriate.

It important to ensure public engagement and effective communication to prepare a community for an impending drought. Poor communication causes the erosion of trust and public support (Dilling *et al.*, 2019). According to table 4.9 and figure 4.4, the majority

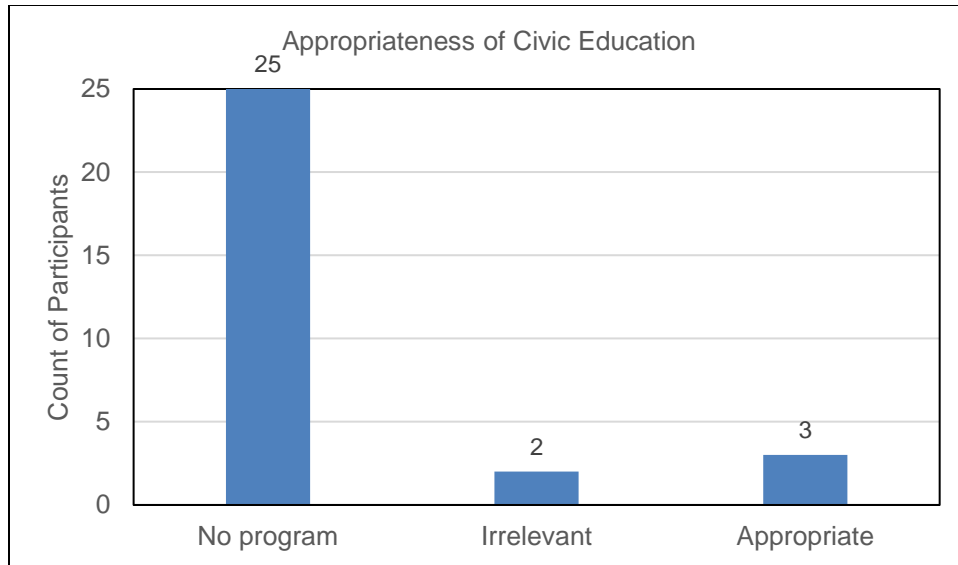
of the respondents indicated that they were not properly prepared and no awareness campaigns were done that were relevant to drought issues. This can lead community members to panic and not to trust the municipality. According to Enqvist and Ziervogel (2019) poor communication has led the community of Cape Town to panic during drought. The municipality of Maluti-a-Phofung has experienced lot of protests which were mostly caused by a lack of communication and poor public engagement.

Furthermore, proper communication and public engagement enable communities to accept the intervention the drought team or the municipality organises. During the interviews of municipal employees at management level, management reported that some of the community members were seen refusing some of the interventions that were instituted by government. One of the interventions that made headlines in the area of Qwaqwa was tankering and the installation of *Jojo* tanks. The community wanted water from taps while their water sources were dry. This is a clear indication of a situation where a community no longer trusts the municipality.

**Table 4.9: Municipal civic education programmes provided to save water**

Did the municipality provide all the water users with civic education to save water?		
	Respondents Municipal officials at non-management level	Percentage
Yes	5	17%
No	25	83%
Total	30	100%

Below, Figure 4.4 further shows that the municipality did not put an effort into conducting an awareness campaign to educate the local communities about effective and efficient water management techniques. The community was ill-prepared for the drought and suffered its negative impacts as a result.



**Figure 4.4: Civic education programmes provided to the communities regarding drought**

#### 4.4.3 Intervention done by the municipality

The livelihoods of communities are mostly dependent on the availability of a water supply (Van Loon *et al.*, 2015). Water Services Authorities are entrusted with the responsibility of ensuring access to water services and to have mitigation plans in place in case of disasters or emergencies. If this responsibility is not implemented accordingly, the livelihoods of communities can be affected negatively. Drought can worsen an already poor situation if not properly mitigated. Municipalities are expected to come up with short-term and immediate interventions during a drought. According to the disaster management act, a municipality should develop a business plan for drought intervention and request drought relief funds from the Department of Cooperative Governance and Traditional Affairs (COGTA).

Maluti-a-Phofung LM still has challenges in developing their drought management policies; demand management strategies; and water services bylaws. This makes it difficult for the municipality to enforce issues of water restrictions and other related issues of misuse of water by community members.

According to Abedin, Habiba, and Shaw (2014), water source alternatives and methods of supplying water for domestic purposes during drought periods is vital, and a

contingency plan needs to be put in place to avoid a failing water supply system to the community members.

#### 4.4.3.1 Alternative water sources

Figure 4.5 indicates the water supply methods used by the municipality, community members, and institutions. With respect to households, about 64.3 % of households were getting water through trucks; 27.5% of households were getting water from wells; 5.4% were getting water from boreholes; 1.6% of households were getting water through taps; and 1% of households had to come up with other alternatives.

Educational institutions were also affected by the drought. Figure 4.5 indicates that 92.5 % received water through trucks; 3.3% had to fetch water from wells; 2% of educational institutions were receiving water from taps; and 2% received water from boreholes

Furthermore, health institutions were also affected by the drought. Figure 4.5 indicates that 93.2% received water through trucks; 3.4% were getting water from boreholes; 2% had to fetch water from wells; and 1.4 % of health institutions received water from taps.

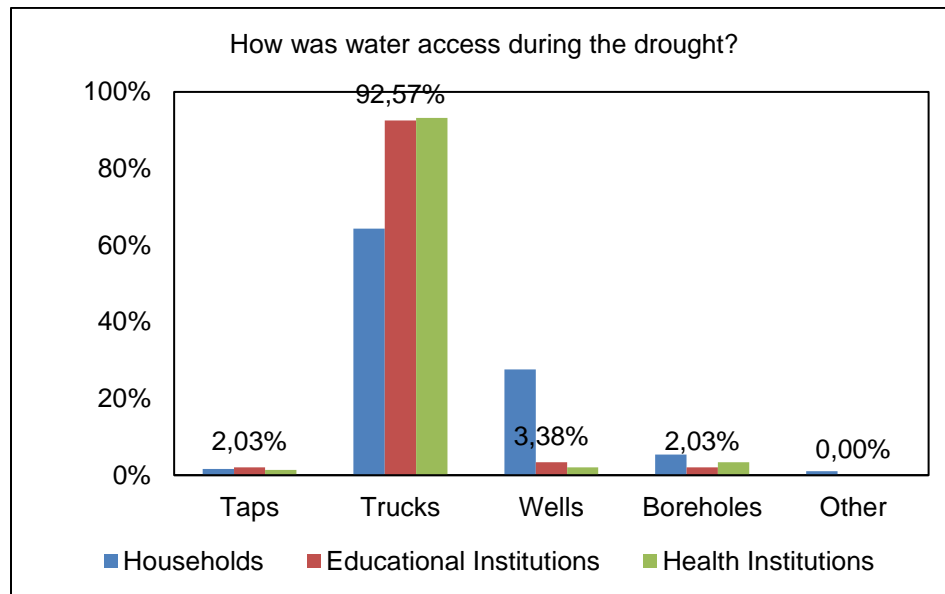


Figure 4.5: Water supply methods used during drought

#### 4.4.3.2 Water restrictions implemented by the municipality

The Figure 4.6 below shows how respondents answered as to whether the municipality implemented water restrictions or not. According to Figure 4.6 the majority of respondents indicated that the municipality did not implement restrictions. About 69% of the respondents indicated that there were no water restrictions; 17% of respondents indicated there were water restrictions at level 4; 6% of respondents indicated that there were water restrictions at level 3; 5% of respondents indicated that there were water restrictions at level 2; and 3% of respondents indicated there were water restrictions at level 1.

According to Kenney *et al.* (2004), one of the key interventions that should be employed by municipalities is a water restriction approach. According to the interviews held with the municipal officials at management level, municipality has no by-laws to implement water restrictions properly.

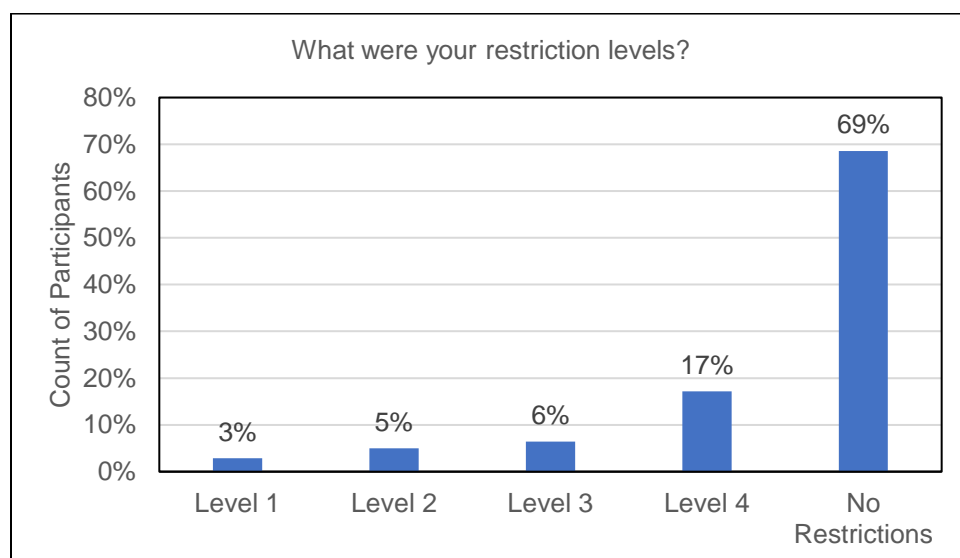


Figure 4.6: Water restriction implementation

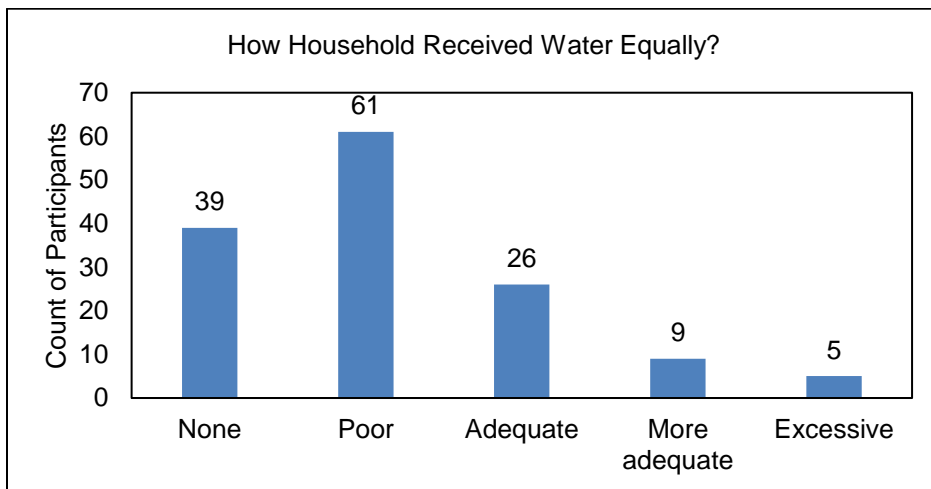
#### 4.4.4 The quality of service during drought

##### 4.4.4.1 Distribution of water to the communities

Owing to the drought, the majority of areas experience water supply shortages and an uneven distribution of water in local communities. Below, is Figure 4.7 that indicates how



water was received at a household level. It shows whether or not water was supplied equally and evenly at household level. Of one hundred forty (140) respondents (municipal officials at non-management level and community members), thirty-nine (39) respondents reported not having received water at all, while sixty-one (61) reported having received water poorly. This implies that of one hundred forty (140) respondents, an overwhelming majority of hundred (100) respondents were not happy about how water was supplied to their communities.



**Figure 4.7: Household water supply survey**

#### 4.4.4.2 Quality of water distributed to the communities

Water quality was also an issue during the drought, alongside the poor and uneven water supply. Hydrological droughts can have negative effects on the quality of the water (Nosrati, 2011). Table 4.10 shows that 40% of the sample population received poor quality water during the drought, with 20% receiving average quality of water, 35% receiving good water quality and only 5% receiving excellent water quality.

**Table 4.10: House water quality survey**

Quality of Water		
	Count of Respondents	
Poor	56	40%
Average	28	20%
Good	49	35%

Excellent	7	5%
Total	140	100%

#### 4.4.4.3 Reliability of water supply during drought

According to Amit and Sasidharan (2019), water supply reliability and water quality are always a problem. Municipalities find themselves in a situation in which they are failing to keep up with their water supply schedules, especially when there is poor planning. Figure 4.8 indicates that ninety-two (92) respondents out of a sample of 140 respondents (community members and municipal officials at non-management level), indicated that the service for water supply was not reliable, while thirty three (33) respondents answered that the water supply service was less reliable. Furthermore, thirteen (13) respondents indicated that the water service delivery was reliable, while seven (7) respondents indicated that it was very reliable. According to Figure 4.8 below, the majority of the respondents were unhappy with the water services in terms of reliability.

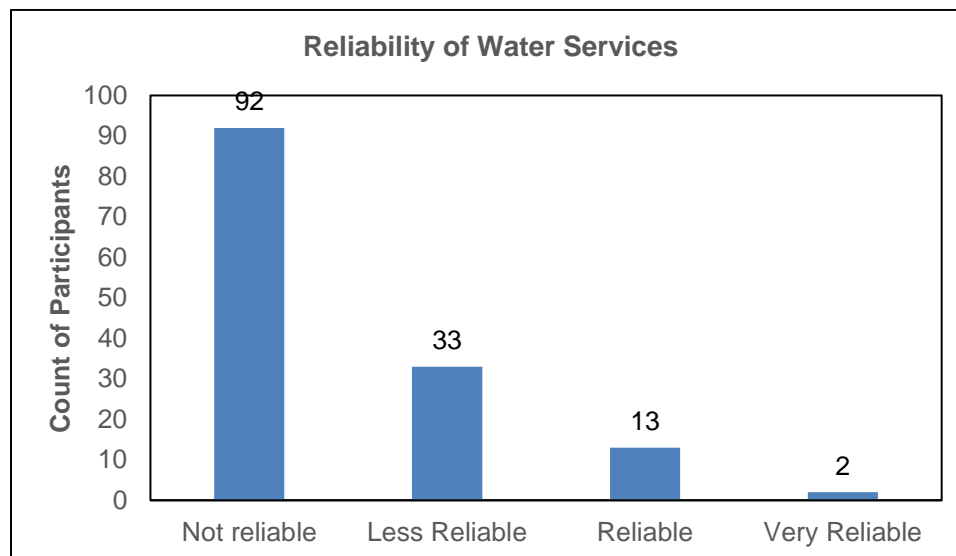


Figure 4.8: Reliability of water services

#### 4.4.4.4 Distance travelled to fetch water

According to table 4.11, 49% of the respondents fetch water at a distance of more than 200 metres; 21% of respondents reported getting water at a distance of between 100 to 200 metres; while 28% reported to fetch water within 100 metres. Only 2% were getting water within their yard.

According to the Free Basic Water policy of South Africa, everyone has a right to free basic water supply. The policy also mandates Water Services Authorities to provide at least 25 litres per person per day of free water for basic needs within 200 m from home. The situation of collecting water from remote sources can negatively affect school-going children, since they will have to bunk classes in order to fetch water for their parents. In other countries, pre-school children between the ages of 4-6 years were found to be fetching water from the river every day for washing, and bathing (Ekpo, Laja-Deile, Oluwole, Sam-Wobo, & Mafiana, 2010).

**Table 4.11: Distance travelled to get water**

Distance Travelled To Get Water		
	Count of respondents (Community members and municipal officials at non-management level)	Percent
Within yard/property	3	2%
Less than 100m	39	28%
100m - 200m	30	21%
More than 200m	68	49%
Total	140	100%

## 4.5 CONCLUSION

The aim of this chapter focused on establishing if the municipality under study contributed to the impact of drought in the community of Qwaqwa, as well as the impact of hydrological drought in terms of water supply to the communities. The analyses were

based on the research questions and hypothesis that provided an understanding of hydrological drought, and properly managed water service to reduce the severity of drought in the communities. Water services authorities are mandated to ensure water service delivery to communities and to ensure proper planning for water supply.

Based on the findings, Maluti-a-Phofung LM clearly had challenges in managing hydrological drought that in turn, impacted on communities' livelihoods. Poor communication and the lack of public engagement on hydrological drought, together with the abysmal state of water resources has also fuelled the severity of drought. The severity of hydrological drought was not felt by the households only, but also by educational and health institutions in the municipal area.

It is important for good hydrological drought management to be applied to municipalities. Sound practice of hydrological drought management will guarantee a continued water supply to the communities and will positively affect the livelihoods of the households. Local communities will also have confidence in the municipality that will in turn help the municipality to plan for hydrological drought with the community.

## **CHAPTER 5**

### **SUMMARY, RECOMMENDATIONS, AND CONCLUSIONS**

#### **5.1 INTRODUCTION**

This chapter provides a summary of the work that has been done in the previous chapters, in order to provide a summary of recommendations and a conclusion to the study. Therefore, chapter five includes an interpretation of the findings and provides what has been achieved. This is done through summarising the findings and indicating as to whether the hypothesis of the study was supported or not, as well as recommending relevant practical methods to be used by municipalities to manage hydrological drought, with specific reference to drought cycle management.

This chapter consists of two sections: the first section will focus on a summary of the findings and the second section focus on the recommendations of the study.

#### **5.2 SUMMARY OF RESEARCH FINDINGS**

The study was designed to assess the impact of hydrological drought management on sustainable livelihoods in Qwaqwa. The research dwelt chiefly on the affected communities. The local communities were able to express their views and experiences of drought and its impact on their livelihoods.

Good management of hydrological drought has been an integral part of reducing the vulnerability of communities to drought risks. Drought cycle management is the model the study is centred on for assessing how the Maluti-a-Phofung Local Municipality manages hydrological drought in mitigating the risk and reducing drought vulnerability in its communities. It further addresses briefly the perception of gender on the experience of drought.

## **5.2.1 Hydrological drought management in the municipality**

Maluti-a-Phofung Local Municipality has a water entity which is called Maluti-a-Phofung water. The water entity runs the water and sanitation services on behalf of the municipality. The municipality has been facing serious water supply problems ranging from water sources to water reticulation. The challenges of water resources and water services range from poor planning; a lack of bylaws; a lack of strategic planning; a lack of management of water resources; to a lack of capacity to implement water services functions.

### **5.2.1.1 Water resource management**

Water resource management has been identified as one of the issues that municipalities battle to implement. Municipalities with specific water services authorities tend to run into trouble when faced by hydrological drought. They normally do not have proper systems to manage water resources which play a major role in determining early warnings of drought immanence.

According to the outcomes of the interview, the municipality does not have the capacity to manage water resources. Although this function also sits with the Department of Water and Sanitation, municipalities should work together with the department to avoid the poor management of water resources. This has led to a situation in which water restrictions were imposed incorrectly.

### **5.2.1.2 Water restrictions**

Proper water resource management allows the municipality to introduce water restrictions on time. Owing to a lack of proper water resource management, Maluti-a-Phofung LM does not have early warning systems and thus, leads to a situation wherein they are unable to provide proper advice with regard to the drought mitigation process. Without early warning systems, the municipality was unable to establish or implement water restrictions on time, so as to reduce the severity of the drought.

They failed to introduce water restrictions at an early stage of the drought. According to the management of the municipality and the majority of community members, water restrictions were introduced only when the situation was at a dire stage. Some respondents referred to the water restrictions as forced restrictions. Without the early introduction of water restrictions it simply implies that communities were informed only late about the drought affecting the water supply.

### **5.2.1.3 *Public preparedness and awareness on hydrological drought***

According to the outcomes of the survey done with the municipal non-management-level employees, the municipality did not conduct public awareness or prepare the communities for the drought. This led to a situation wherein most of community members thought that the drought was created because they were demanding water from their taps. Public engagement was done only when communities were already having problems with water supply.

## **5.2.2 Hydrological drought interventions by the municipality and other stakeholders**

Drought management is the responsibility of all three spheres of government. The national department has a duty to support the sphere of government with funds for drought relief and technical support when needed. Water Services Authorities are also required to come up with water supply alternatives for their communities during drought. Most of the time, municipalities tend to employ expensive methods to offset the results of poor planning and a lack of mitigation strategies that should have been adopted by the Water Services Authorities.

According to the findings, Maluti-a-Phofung LM did not mitigation and recovery plans for drought. It was understood this was caused mostly by a lack of stability in the municipality since 2015. The municipality was without proper water master plans and maintenance plans for their water infrastructure. This has led to a situation where the municipality was

unable to manage drought conditions. The municipality, with the support from other stakeholders, was able to provide water trucks and drilling of boreholes.

According to the findings, water tankering dominated as the alternative method of supplying water to the communities. The water tankering method was seen not as an effective and reliable method for the majority of the community members. The assumption is that this could have been caused by the huge demand, due to the high population. Owing to an escalation in the demand for water, water trucks were expected to be increased and this was seen as an expensive method, since the community of Qwaqwa is large.

Groundwater exploration was one of the intervention methods implemented by the municipality and this was done as an alternative water source. According to the findings, boreholes were rated as the second intervention after water trucks. Boreholes were drilled and equipped mostly around the community at strategic places to ensure access to water supply and the minimisation of water trucks.

However as indicated above, the turnaround of water trucks was very slow and some community members were left without water for long periods. This led to a situation in which affected community members had to collect water from their nearby wells. The quality of water from these wells is always questionable, since there is a lot of pollution around communities. This said, community members had no choice since Qwaqwa is regarded as a rural area with low income. This implies that most community members were not able to afford water from private venders.

### **5.2.3 The effect of hydrological drought on households**

When municipalities are affected by drought, the impact turns out to be high for communities and institutions within those municipalities. Hydrological drought can affect municipalities' ability to supply water to communities. Maluti-a-Phofung LM was one of the municipalities failing to supply water to its communities.



Most of the areas of Qwaqwa were unable to get water from their taps. As indicated previously, community members were forced to collect water from wells and by queueing for water tankers. Some of the households had to fetch water more than 200 metres away, while others had to buy water from venders. Those who were not able to afford to buy water were hit hard by the drought.

According to the report findings, not only were communities affected by the hydrological drought but educational and health institutions as well. Most institutions were dependent on water supplied by water tankers which made it difficult to operate normally. Health institutions were reported to be especially highly affected since they needed water with high pressure to be able to reach wards in the hospitals.

As previously indicated, a majority of households reported that the water supply in their areas was not reliable. This implies that most of their livelihood activities that require water, such as gardening, and car washing were affected. Water plays a significant role in terms of food security, especially in rural areas.

Moreover, drought did not affect the communities and institutions only. The municipality was also affected, since it survives mostly on revenue collection. According to the management of the municipality, the revenue collections dropped drastically due to less payments by communities.

The study further assessed the effects of drought based on gender. According to the outcomes, females were found to be hardest hit by drought at household level. This was mostly because women are the ones who often take care of household activities, such as cooking, washing, and bathing children.

### **5.3 RECOMMENDATIONS**

Hydrological drought is complex and negatively impacts on the livelihoods of households if not properly managed. It can affect surface water and groundwater supplies. The amount of water level in the dams, rivers, lakes, and reservoirs reduces when drought continuously persists. A lack of proper management can lead to a disastrous situation.

The outcome of the study shows that Maluti-a-Phofung LM is struggling to manage hydrological drought in their area. The municipality did not follow proper steps in the management of drought in general. The approach used by the municipality was more of a reactive strategy, rather than being proactive, especially since it was not the first time the municipality has experienced drought. The intuitional capacity was not geared to address or manage hydrological drought, as they had no resources including proper human resources.

It is recommended that Maluti-a-Phofung be capacitated properly to manage hydrological drought. Despite the challenge, the municipality does not have a drought cycle management model to deal with hydrological drought. The municipality should develop a drought mitigation plan to minimise drought effects. This said, it is difficult for municipalities to budget for drought recovery interventions due to a lack of funds and that their collection revenue is very low. However, drought is not the responsibility of municipalities only but all spheres of government.

Section 154 of the South African constitution mandate Nation and Provincial government to provide support and capacity to municipalities to be able to perform its mandate. Therefore, District Municipality, Provincial and National Government assist a municipality to recover from drought. The District Municipality should establish effective and efficient disaster centres to promote a coordinated and integrated approach to disaster management in the municipal area, as indicated in section 42 of Disaster Management Act No 57 of 2002. The disaster management centre will be responsible for properly guiding the municipality to develop drought management strategies and drought recovery plans.

The Department of Water and Sanitation as the custodian of water resource management should assist a municipality in establishing a water resource management committee to enable it to monitor and manage water resources. This will help in stablishing early warnings and advise communities accordingly.

After the establishment of a centre for water resources, there should be a strategy in place for effective public awareness programmes to provide information (on water safety,

conservation, dam levels, demand management), for dissemination through media platforms and community engagement forums.

It is further recommended to implement water demand management and water restriction management and the latter should be informed by early warning systems with regard to the level of water resources in the dams. A model should be developed to guide the municipality as to when to implement certain water restrictions.

The disaster management centres, with the support from provincial and national departments, including affected stakeholders should establish short-, medium- and long-term interventions required for drought intervention and management.

- Short term interventions basically refer to immediate interventions, such as water restrictions, alternative water sources and unregulated water delivery systems, such as water trucks, rivers and wells.
- Medium-term interventions, such as the expansion of water storage capacity, the introduction of rainwater harvesting, implementation of leak detection and mitigation practices to reduce water losses should be initiated. The recycling of grey water for irrigation use is also crucially important.
- Long-term solutions should include facilitating investments in major water infrastructure development. The development of reliable water sources for the community of Qwaqwa is needed. The national department should assist the municipality with funding for long-term solutions.

The disaster management centre should further assist the municipality with the development of water safety plans and water bylaws. Water utilities and other service providers should develop efficient plans in line with water safety regulations.

## **5.4 CONCLUSION**

In conclusion, it is clear that a lack of proper management of hydrological drought has an influence on the increasing drought effects on a community and society at large. Communities which are found to be facing serious water shortages, are then forced to

collect water even from sources shared with cattle, goats and other animals for them to be able to cook and drink. Proper water resource management is an integral part of hydrological drought management and a municipality should be able to detect timeously if water resources are depleting; whether intervention including restrictions is required or not. Complying with the requirements of the national water strategy and water acts, in developing master plans and guiding documents for water service implementation are fundamental to the success or failure of municipalities in dealing with hydrological drought. It should be stated that a lack of trust and engagement from communities also severely impact on the implementation of a municipality's mitigation plan, as in the case of water tankers being rejected by some community members. It is important to have proper engagement with communities at all times to avoid community protests. During the times of drought, it is essential that a municipality works with the community and provincial and national departments, including affected stakeholders and non-governmental organisations.

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## APPENDIX A: SURVEY QUESTIONNAIRE FOR COMMUNITY MEMBERS

### QUESTIONNAIRE FOR ASSESSING THE IMPACTS OF HYDROLOGICAL DROUGHT MANAGEMENT ON SUSTAINABLE LIVELIHOODS IN QWAQWA, SOUTH AFRICA

Date of Interview (yyyy/mm/dd): \_\_\_\_\_

Questionnaire number (For admin. purposes only): \_\_\_\_\_

Thank you for participating in this study. Please take note that this study is intended for academic purposes only. The information that will be generated will only be used for this study and knowledge enhancement. Community members should feel free and comfortable to answer all questions in this questionnaire. Please tick the most appropriate answer to the following questions.

#### **Section A: Demographic Information**

**1. What is your gender?**

- 1) Male
- 2) Female

**2. What is your age?**

- 1) Between 18 and 25 years
- 2) Between 26 and 30 years
- 3) Between 31 and 40 years
- 4) Between 41 and 55 years
- 5) 56 and above

**3. What is your home language?**

- 1) Sepedi
- 2) Sesotho
- 3) Setswana
- 4) Afrikaans
- 5) English

6) Other, please specify: \_\_\_\_\_

**4. Area of Involvement:**

- 1) Community member
- 2) Municipal official

**5. What is your marital status?**

- 1) Single
- 2) Married
- 3) Separated
- 4) Divorced
- 5) Widowed

**6. What is your educational level?**

- 1) None
- 2) Primary
- 3) Secondary
- 4) College
- 5) University

**7. What is the size of your household?**

- 1) 1 to 3 people
- 2) 4 to 6 people
- 3) More than 6 people

**Section B: Drought Information**

**8. Did you know about the drought in 2015/2016?**

- 1) Yes
- 2) No

**9. If yes, were you affected by the drought in your area?**

- 1) Yes
- 2) No

**10. What is your understanding of the drought in 2015/2016?**

- 1) Did not receive enough rainfall for about a year
- 2) Water was not available for three days due to infrastructure repairs
- 3) Community did not pay for their water
- 4) Municipality did not pay Department of Water and Sanitation for the raw water
- 5) Municipality did not pay water boards

**11. How were you informed about the drought in your area?**

- 1) TV
- 2) Friends
- 3) Radio
- 4) Newspaper
- 5) Municipal communication
- 6) Other, please specify: \_\_\_\_\_

**12. Were you prepared for the drought in your area?**

- 1) Prepared (Ready to withstand water shortages)
- 2) Partially prepared (Partially ready to withstand water shortages)
- 3) Not prepared (Not ready to withstand water shortages)

**13. What were the drought effects like in your area?**

- 1) Low
- 2) Moderate
- 3) High
- 4) Very high

**14. Were restrictions implemented during the drought?**

1) Yes

2) No

**15. If yes, what were your restriction levels?**

1) Level 1 – Normal conditions

2) Level 2 – Dry conditions

3) Level 3 – Very dry conditions

4) Level 4 – Emergency conditions

5) No restrictions were issued

**16. How often was drinkable water supplied during the drought?**

1) Often

2) Not often

3) Never

**17. How did the drought affect the educational institutions such as crèches, schools, colleges, and universities in your area?**

1) Low

2) Moderate

3) High

4) Very high

**18. How did the drought affect the health institutions such as clinics and hospitals?**

1) Low

2) Moderate

3) High

4) Very high

**19. During the 2015/2016 drought period, how do you rate Maluti-a-Phofung in terms of the provision of water supply during the drought?**

**a) Every household received water equally:**

- 1) None
- 2) Poor
- 3) Adequate
- 4) More adequate
- 5) Excessive

**b) The quality of the provided water was:**

- 1) Poor
- 2) Average
- 3) Good
- 4) Excellent

**c) Water was affordable to everybody in your area:**

- 1) Not affordable
- 2) Less affordable
- 3) Affordable
- 4) Very affordable

**d) Water services were reliable (water was supplied all the time):**

- 1) Not reliable
- 2) Less reliable
- 3) Reliable
- 4) Very reliable

**20. How did you access water during the drought? (Multiple responses are allowed)**

- Through taps
- Through trucks
- Through wells
- Through boreholes
- Other, please specify: \_\_\_\_\_

**21. How did educational institutions access water during the drought? (Multiple responses are allowed)**

- 1) Through taps
- 2) Through trucks
- 3) Through wells
- 4) Through boreholes
- 5) Other, please specify: \_\_\_\_\_

**22. How did health institutions access water during the drought? (Multiple responses are allowed)**

- 1) Through taps
- 2) Through trucks
- 3) Through wells
- 4) Through boreholes
- 5) Other, please specify: \_\_\_\_\_

**23. What distance did you travel to fetch water?**

- 1) Within the yard/property
- 2) Within 100 m
- 3) Between 100 m and 200 m
- 4) More than 200 m

**THANK YOU FOR YOUR COOPERATION AND PARTICIPATION IN THIS STUDY.**

## APPENDIX B: SURVEY QUESTIONNAIRE FOR MUNICIPAL OFFICIALS AT NON-MANAGEMENT LEVEL

### QUESTIONNAIRE FOR ASSESSING THE IMPACTS OF HYDROLOGICAL DROUGHT MANAGEMENT ON SUSTAINABLE LIVELIHOODS IN QWAQWA, SOUTH AFRICA

Date of Interview (yyyy/mm/dd): \_\_\_\_\_

Questionnaire number (For admin. purposes only): \_\_\_\_\_

Thank you for participating in this study. Please take note that this study is intended for academic purposes only. The information that will be generated will only be used for this study and knowledge enhancement. Municipal officials should feel free and comfortable to answer all questions in this questionnaire. Please tick the most appropriate answer to the following questions.

#### **Section A: Demographic Information**

**1. What is your gender?** (please cross (X) or tick (✓) your chosen box)

Male	Female
<u>1</u>	<u>2</u>

**2. What is your age?** (kindly cross (X) or tick (✓) your chosen box)

18 to 25 years	26 to 30 years	31 to 40 years	41 to 55 years	56 and above
1	2	3	4	5

**3. What is your home language?**

- 1) Sepedi

- 2) Sesotho
- 3) Setswana
- 4) Afrikaans
- 5) English
- 6) Other, please specify: \_\_\_\_\_

**24. Area of Involvement:**

- 1) Community member
- 2) Municipal official

**25. What is your marital status?**

- 1) Single
- 2) Married
- 3) Separated
- 4) Divorced
- 5) Widowed

**26. What is your educational level?**

- 1) None
- 2) Primary
- 3) Secondary
- 4) College
- 5) University

**27. What is the size of your household?**

- 1) 1 to 3 people
- 2) 4 to 6 people
- 3) More than 6 people

**Section B: Drought Information**



**28. Did you know about the drought in 2015/2016?**

- 1) Yes
- 2) No

**29. If yes, were you affected by the drought in your area?**

- 1) Yes
- 2) No

**30. What is your understanding of the drought in 2015/2016?**

- 1) Did not receive enough rainfall for about a year
- 2) Water was not available for three days due to infrastructure repairs
- 3) Community did not pay for their water
- 4) Municipality did not pay Department of Water and Sanitation for the raw water
- 5) Municipality did not pay water boards

**31. How were you informed about the drought in your area?**

- 1) TV
- 2) Friends
- 3) Radio
- 4) Newspaper
- 5) Municipal communication
- 6) Other, please specify: \_\_\_\_\_

**32. Were you prepared for the drought in your area?**

- 1) Prepared (Ready to withstand water shortages)
- 2) Partially prepared (Partially ready to withstand water shortages)
- 3) Not prepared (Not ready to withstand water shortages)

**33. What were the drought effects like in your area?**

- 1) Low

- 2) Moderate
- 3) High
- 4) Very high

**34. Were restrictions implemented during the drought?**

- 1) Yes
- 2) No

**35. If yes, what were your restriction levels?**

- 1) Level 1 – Normal conditions
- 2) Level 2 – Dry conditions
- 3) Level 3 – Very dry conditions
- 4) Level 4 – Emergency conditions
- 5) No restrictions were issued

**36. How often was drinkable water supplied during the drought?**

- 1) Often
- 2) Not often
- 3) Never

**37. How did the drought affect the educational institutions such as crèches, schools, colleges, and universities in your area?**

- 1) Low
- 2) Moderate
- 3) High
- 4) Very high

**38. How did the drought affect the health institutions such as clinics and hospitals?**

- 1) Low
- 2) Moderate
- 3) High

4) Very high

**39. During the 2015/2016 drought period, how do you rate Maluti-a-Phofung in terms of the provision of water supply during the drought?**

**a) Every household received water equally:**

- 1) None
- 2) Poor
- 3) Adequate
- 4) More adequate
- 5) Excessive

**b) The quality of the provided water was:**

- 1) Poor
- 2) Average
- 3) Good
- 4) Excellent

**c) Water was affordable to everybody in your area:**

- 1) Not affordable
- 2) Less affordable
- 3) Affordable
- 4) Very affordable

**d) Water services were reliable (water was supplied all the time):**

- 1) Not reliable
- 2) Less reliable

- 3) Reliable
- 4) Very reliable

**40. How did you access water during the drought? (Multiple responses are allowed)**

- 1) Through taps
- 2) Through trucks
- 3) Through wells
- 4) Through boreholes
- 5) Other, please specify: \_\_\_\_\_

**41. How did educational institutions access water during the drought? (Multiple responses are allowed)**

- 1) Through taps
- 2) Through trucks
- 3) Through wells
- 4) Through boreholes
- 5) Other, please specify: \_\_\_\_\_

**42. How did health institutions access water during the drought? (Multiple responses are allowed)**

- 1) Through taps
- 2) Through trucks
- 3) Through wells
- 4) Through boreholes
- 5) Other, please specify: \_\_\_\_\_

**43. What distance did you travel to fetch water?**

- 1) Within the yard/property
- 2) Within 100 m
- 3) Between 100 m and 200 m

- 4) More than 200 m

### **Section C: Drought Management**

**44. Are sustainable methods for development and implementation of operating rules for water supply and drought management in relation to all dams in the Qwaqwa area available?**

- 1) Don't exist/No
- 2) Don't know
- 3) Unsure
- 4) Know/Yes

**45. Did the municipality establish a Drought Operating Forum?**

- 1) Don't know
- 2) Yes, but it was not effective / did not meet
- 3) Yes, and it was effective
- 4) No

**46. Did the municipality develop a Drought Business Plan?**

- 1) Not developed
- 2) Developed but not detailed
- 3) Comprehensive with budgets

**47. Did other spheres of government support the municipality financially based on the Drought Business Plan?**

- 1) Yes
- 2) No

**48. If yes, rate the financial support:**

- 1) Budget not available
- 2) Budget was not sufficient

3) Budget was sufficient

**49. Did the municipality provide all the water users with civic education programmes to save water?**

1) Yes

2) No

**50. Comment on the following:**

a) No civic education programmes were available on saving water:

1) Yes

2) No

b) Irrelevant civic education programmes were available on saving water:

1) Yes

2) No

c) Appropriate civic education programmes were developed and provided on saving water:

1) Yes

2) No

**THANK YOU FOR YOUR COOPERATION AND PARTICIPATION IN THIS STUDY**

## APPENDIX C: INTERVIEW GUIDE FOR MUNICIPAL OFFICIALS AT MANAGEMENT LEVEL

### IMPACTS OF HYDROLOGICAL DROUGHT MANAGEMENT ON SUSTAINABLE LIVELIHOOD IN QWAQWA, SOUTH AFRICA

#### Interview Questions (Management at the Municipality)

Thank you for participating in this study. Kindly take note that this study is intended for academic purposes only and information generated will be for academic purpose only. Feel free and comfortable to answer questions in this questionnaire.

<b>1. Biographical information</b>		
1.1	Gender of the Employee	X=Male      Y= Female
1.2	Age of the employee	
1.3	Position of the employee	
1.4	How long have you being in the position?	
1.5	What is your level of qualification?	1. Matric 2. Diploma 3. Degree 4. Honours Degree 5. Masters Degree 6. PhD 7. Other, specify below:

2. How does municipality operate and manage their water resources?

3. During the drought of 2015/16, did the municipality have plans for drought and how did you manage the drought?
4. What type of intervention did the municipality provide to its community members in ensuring water supply during drought?
5. How is the municipality monitoring and evaluating drought?
6. What is the municipality's recovery plan since you had drought?
7. What is the municipality's mitigation plan regarding drought?

**THANK YOU FOR YOUR COOPERATION AND PARTICIPATION IN THIS STUDY**