An Investigation of Farmer's Perception of Water Conservation: A Case Study of Umgababa Community

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DECLARATION

I hereby declare that the work (described) in this dissertation is my original work and has not previously been submitted in its entirety or in part for a degree at any other university. I further declare that this work does not infringe or violate the rights of others, as all the sources cited or quoted are indicated and acknowledged by means of a comprehensive list of references.

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GS Thabethe **Date**

16638614

DEDICATION

This research is dedicated to Christ Caeser Nongqunga, the Lord of unfathomable qualities who had made this research a reality.

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To my parents Mr Jabulani Stanley and Ntombizonke Gasta Thabethe. Your prayers have been nothing short of amazing. They have carried me through the most difficult times in my life. May my God, our Lord keep you for me until all your wishes that you have sacrificed for me come through.

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ABSTRACT

The role and benefit of water to human life and the production environment cannot be over-emphasised hence it is one of the most valuable resources. The objective of the study was to identify the water conservation techniques used in the Umgababa community, to determine if the water conservation techniques used are adaptable, to determine the extent of adaptability of the water conservation techniques used in the Umgababa community. In addition, the study sought to recommend guidelines for sustainable water conservation techniques. Farmers in rural areas face even serious due to the inadequate supply of water, as well as a host of other service delivery challenges.

This study assessed the farmers' perceptions of water conservation with a focus on the Umgababa community in KwaZulu-Natal. A mixed-method approach was employed for the study. Sixty-one (61) respondents completed the questionnaires while three (3) interviewees participated in the semi-structured interview. The data was analysed both descriptively and inferentially, while thematic analysis was used in evaluating the transcribed feedback from the interviewees.

The study revealed that the farmers have a positive perception of water conservation techniques and that basic water conservation techniques, such as the use of JoJo tanks and boreholes are currently in place. Even though the existing techniques are sustainable, not much focus has been given to other sophisticated water conservation methods that could be implemented in Umgababa. It was further revealed that the existing public awareness and education campaigns should be continued, to change residents' existing water conservation behaviours and culture.

The study recommended the need for the Department of Water and Sanitation to increase educational campaigns to the community and rural farmers and devise a workable plan that will assist in measuring the effectiveness of the awareness campaigns. It is, also, important for the existing water conservation techniques to be maintained, while other types of conservation practices such as shift cultivation, rainwater harvesting and mulching, which are available in South Africa be deployed to the Umgababa community. Additionally, existing water infrastructure to the community such as water pipes should be adequately serviced and maintained.

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CAADP	Comprehensive Africa Agriculture Development Programme
DWS	Department of Water and Sanitation
IFAD	International Fund for Agricultural Development
NWA	National Water Act
NWRS	National Water Resource Strategy
OECD	Organisation for economic cooperation and development
PWP	Planting Without Ploughing
RDP	Rural Development Programme
SA	South Africa
SDG	Sustainable Development Goals
SPSS	Statistical Package for the Social Sciences
UN	United Nations

CHAPTER 1
INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

Every facet of human life is somehow connected to water ranging from home use to agricultural and industrial use (Dinka, 2018). The United Nations (UN) and several of global economies declared access to quality drinking water as a basic human right and ultimately leads to improved living standards (Dinka, 2018). From a Southern African region's perspective, problems that are related to water vary in many ways (Soyapi, 2017). These include the outbreaks of cholera in Zimbabwe, and difficulties in accessing basic water services and municipal issues, which highlight the need for water to remain a central focus for any government (Soyapi, 2017). This study investigates farmers' perceptions towards water conservation in the community of Umgababa, specifically the Umnini area. This chapter outlines the study background, problem statement, study significance, objectives of the study, research questions, research methodology and chapter arrangement.

1.2 BACKGROUND

Water is among South Africa's most valuable resources. However, the scarcity of this resource has undermined the performance and growth of sectors such as agricultural, industrial, mining and domestic sectors, and a host of other segments of the economy. It is said that water scarcity directly affects an estimated 20 million South Africans (Otieng & Ochieng, 2007). Some of the issues facing water in South Africa include available quantity, uneven supply and access to clean water, the quality and condition of water infrastructure, droughts that result in drying up of towns and dishonesty that has crept into the municipal treatment plants, leading to sewage flows into streets and contamination of groundwater (Adam, 2021). However, the impact of this scarcity is felt more on the rural communities in South Africa that rely heavily on natural resources. Access to water is a fundamental human right in South Africa, even though some rural communities are yet to benefit from this right (Soyapi, 2017). It is imperative that the water scarcity challenges are addressed because water resource security is associated with water usage,

development, conservation, management and control. Hence, the national government needs a robust policy transition that will address water conservation and satisfy the demand for water (Adam, 2021).

Umgababa is a rural community area with a large marketplace for tourists in the province of KwaZulu-Natal in South Africa. The main challenge of the community of Umgababa is the inadequate of water supply for domestic, agricultural and industrial purposes (Vasanthavigar, Srinivasamoorthy and Prasanna (2012). This inadequacy of the water supply has adverse effects on the Umgababa community (Vasanthavigar, et al., 2012). It has constrained development in the agricultural sector and slowed the pace of tourism. This inadequacy, amongst other challenges, has also affected the livelihood of the community. A couple of years back, the Umgababa area was thrown a lifeline to the value of R10.8 million for a water project, which was expected to improve water supply to the area (Mtshali, 2016).

The importance of water conservation cannot be overemphasised. According to Ruijs, Zimmermann and van den Berg (2008), water conservation is vital because water is essential for life. In addition, basic water conservation techniques lead to savings, hence less water usage results in lower financial charges for water. On the contrary, a poor water conservation method can lead to other issues in the long run, such as resistance to low-flow toilets and showerheads due to inadequate water (Ruijs, et al., 2008). Water conservation methods also rely on behavioural changes, and these may necessitate ongoing educational efforts to maintain water-saving habits (Mtshali, 2016). Residents and farmers living in the Umgababa area, have over time, encountered numerous interruptions of water, which contributed to one of the municipality's initiatives towards water conservation in the event of a drought (Mtshali, 2016). Hence, the study was centred on investigating the perception of farmers towards water conservation with the Umgababa community as a case study.

1.3 RESEARCH PROBLEM

According to Noga and Wolbring (2013), not much has been done in educating people on water conservation and water harvesting among rural households of South Africa. Water is a scarce resource, particularly amongst provinces, such as the North West, Free State as well as the KwaZulu-Natal province where the Umgababa community is situated (Noga & Wolbring, 2013). This scarcity has brought about the need for stakeholders in the water sector to use more pragmatic approaches to address water scarcity across the country (Damkjaer & Taylor, 2017). However, this water scarcity is more severe in rural communities, due to the inadequacy of water infrastructure (Damkjaer & Taylor, 2017). According to Murtinho, Tague, Bievre, Eakin and Lopez-Carr (2013), exacerbating the water scarcity or water challenge in rural communities is the poor perception around "water" itself. This scarcity has brought about the need for stakeholders in the water sector to use approaches that are more realistic in addressing water scarcity across the country (Murtinho, et al., 2013).

The predominantly rural community of Umgababa in Ward 98 of the eThekwini Municipality of KwaZulu-Natal also faces similar water challenges faced to other rural communities of South Africa (eThekwini Municipality, 2014). The main recurring water-related issue in this community is the "unreliability of water" (Damkjaer & Taylor, 2017). To tackle this issue, public agencies and water utilities such as the Department of Water and Sanitation (DWS) have used information campaigns to encourage water conservation (eThekwini Municipality, 2014). According to Govender, Grobler and Joubert (2015), DWS also attested that many more awareness campaigns are still needed, particularly in rural communities. Education and training on water conservation are imperative (Govender, et al., 2015). This is especially in the community of Umgababa, as it is obvious that households of this community require significant knowledge on conserving water as a means to having a better livelihood. In view of the concerns raised above, the need to study people's attitudes and perceptions on water conservation among rural

communities in South Africa is imperative. This study is aimed to assess such perceptions, using the Umgababa community as a case study.

1.4 SIGNIFICANCE OF THE STUDY

KwaZulu-Natal and various municipalities will benefit greatly from this study as it will assist them in understanding the residents' perceptions of water conservation initiatives. The outcome of this study can also be used as a benchmark in assessing the perception of residents and farmers in other municipalities within the province. This study will contribute towards improving and encouraging rural residents and farmers' awareness of the benefits of water conservation, and to embrace this initiative as a proven successful approach adopted by many economies across the globe. Furthermore, this study is expected to support a potential campaign by the South African government in accelerating the awareness of citizens, farmers and residents of various communities of the vital benefits of water conservation measures. Additionally, policymakers and stakeholders can also leverage the benefits of this study in develop legislation that will preserve water in South Africa for future water conservation purposes.

1.5 AIM OF THE STUDY

The main aim of this study was to investigate the perception of Umgababa community household farmers towards water conservation.

1.6 STUDY OBJECTIVES

To achieve the aim of the study, the objectives below were identified:

- To identify the water conservation techniques used in the Umgababa community;

- To determine if the water conservation techniques used are adaptable;
- To determine the extent of adaptability of the water conservation techniques used in the Umgababa community, and
- To recommend guidelines for sustainable water conservation techniques.

1.7 RESEARCH QUESTIONS

The study answered the following research questions:

1. What are the water conservation techniques used in the Umgababa community?
2. What are the water conservation approach currently used that are adaptable?
3. What is the extent of adaptability of the water conservation techniques used in Umgababa community?
4. What are the guidelines for sustainable water conservation techniques?

1.8 RESEARCH METHODOLOGY

It is normal for a research method to be grouped into various categories, depending on the nature and aim of the study (Flick, 2018). Research methods are generally classified as quantitative, qualitative or the mixed methods (Cooper & Schindler, 2011). The quantitative method deals with situations using numerical methods, the qualitative study gathers and evaluates information utilising inferences to draw conclusions, while the mixed method combines quantitative and qualitative research methods (Flick, 2018). This study employed a mixed-method approach for the collection and analysis of data.

The sample population consisted of a total of 80 subsistence and smallholder farmers living in Umgababa. For the quantitative data gathering, the researchers

used a non-probability sampling method in selecting the study participants and specifically narrowed down the approach to judgemental (purposive) sampling, out of which a total of 61 participants received and completed the study questionnaires. In terms of qualitative data collection, a judgemental sampling method was also used, and five interviewees were selected for the semi-structured interview, even though only three completed the interview forms. The semi-structured interview was carefully set up to ensure correctness of wordings. Judgemental sampling has the benefit of being time efficient and cost-effective (Creswell & Creswell, 2018).

For the quantitative analysis of the data, the information from the questionnaires was transferred into Microsoft Excel and analysed using the Statistical Package for the Social Sciences (SPSS) version 25. The researcher adopted both descriptive and inferential statistical approaches for the data analysis. For the qualitative data analyses, the researcher utilised thematic analysis. The thematic evaluation uses the means of recognising, analysing and outlining patterns (also known as themes) in the collected data (Dudovskiy, 2018).

Maintaining ethical values is a critical part of good research (Flick, 2018). The researcher employed the necessary ethics during the study, to ensure that focus was given to compliance towards the needed guidelines as stipulated by the faculty research ethics committee. In addition, the ethics committee approved the research on the 3 March 2020. The researcher also ensured that the participants were not exposed to any form of personal harm or injury as a result of the study. All the participants and interviewees were made aware of the fact that it was their individual choice to be part of the study. In the same manner, personal consent forms were signed by the participants prior to their involvement in the questionnaire completion or semi-structured interview. Hence, the researcher ensured that no participant was coerced to be involved in the study.

1.9 LIMITATIONS OF THE STUDY

This study focused on the farmers' perception of water conservation in the Umgababa community. The scope of this study was limited to smallholder and subsistence farmers in Umgababa. The general community who had no knowledge about farming and the needs of water conservation were not involved in the study. In addition, the scope of the study did not consider other nearby communities or settlements.

1.10 STRUCTURE OF DISSERTATION

Chapter 1 – Introduction

This chapter provides an overview of the current study. Aspects such as aim, objectives, problem statement and significance of the study were discussed.

Chapter 2 – Literature Review

This chapter presents recent literature in line with the study's aim, objectives and problem statement

Chapter 3 – Research Methodology

This chapter outlines the procedures and steps used in collecting the data.

Chapter 4 – Presentation of Results

This chapter outlines the results from the data collection and encompasses both qualitative and quantitative data collection.

Chapter 5 – Discussion of Results and Findings

This chapter reviews the findings from the data presented in Chapter 4. It discusses the patterns and how the outcome correlates with existing theories and literature review concepts.

Chapter 6 – Conclusions and recommendations

This chapter outlines the conclusion of the study in line with the study objectives. It presents summaries under each of the objectives and further outlines the recommendations of the study.

1.11 CONCLUSION

The improved understanding of the essential water conservation practices motivates consumers to embrace water management techniques that are aligned to water conservation, hence the need to understand the perception of farmers towards conservation. This chapter outlined the introduction to the study, related background and the significance of the study. The statement of the problem was outlined, as well as the objectives, research questions, research methodology, limitations and the structure of the study. The next chapter presents the literature review.

CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION

The previous chapter presented the background to the study. This chapter provides relevant literature within the scope of the study's aim and objectives. The narrative in this literature will be structured in line with the main variables - water conservation and farmers' perception of water conservation. Thus, this chapter has been categorised into three main areas. The first area provides an overview of water scarcity from a global perspective and explains why water conservation is imperative. The second area elaborates on water scarcity from a rural perspective and why water conservation is important to rural farmers. Finally, the last aspect provides the conceptual framework.

2.2 KEY DEFINITIONS

This section provides essential definitions that are uniquely applicable to this study.

Subsistence farming: This is known as the type of farming and related activities where the main farming output is consumed directly, such that a minor fraction of the farm produce is sold (Morton, 2007). It is sometimes seen as a type of autonomous farming used in rural communities.

Smallholder farming: This is generally utilised to describe rural farmers, especially in developed countries that farm solely for family labour (Morton, 2007). Under this type, the farm produce remains the core source of income (Morton, 2007).

In this study, both definitions are grouped under one umbrella and deemed to be closely related.

Perception: This deals with the manner or way in which a subject is regarded, understood and interpreted. In order words, to become aware of a thing.

2.3 WATER SCARCITY: IMPORTANCE OF WATER CONSERVATION

This section provides a discussion on water scarcity and why it is an issue at the global, regional and national levels. The discussion was then redirected to water conversation, and why it is critical to the urban and rural populace. More so, discussions on the perception of water conservation; the legislative framework on water within the South African context, as well as the relationship between water conservation and livelihood, are discussed.

2.3.1 Water Conservation on a Global Perspective

Fresh water has always been deemed a vital ingredient for the survival of humans. The foremost development in freshwater was the UN conference in Argentina in 1977, which was convened in response to the developments related to water (Biswas, 1992). There is a sizeable mismatch between fresh water and the world population distribution. As Piesse (2020) highlighted, the world's supplies are forecasted to come under multiplied stress as a result of increased demand due to population growth, increasing wealth levels, dietary change, urbanisation and increasing industrial demand (Piesse, 2020). In addition, the right quantity and quality of water are also not generally available (Biswas, 1992). Several arid and semi-arid countries are presently facing water crisis challenges, and environmental indicators reveal that the problem will increase in severity in the 21st century (Biswas, 2020). In the same manner, the number of water challenges such as floods, scarcity and unclean drinking water are growing globally (Novo, 2020). As these continue to multiply, governmental bodies and organisations are expected to resort to innovative solutions in handling the issue (Novo, 2020).

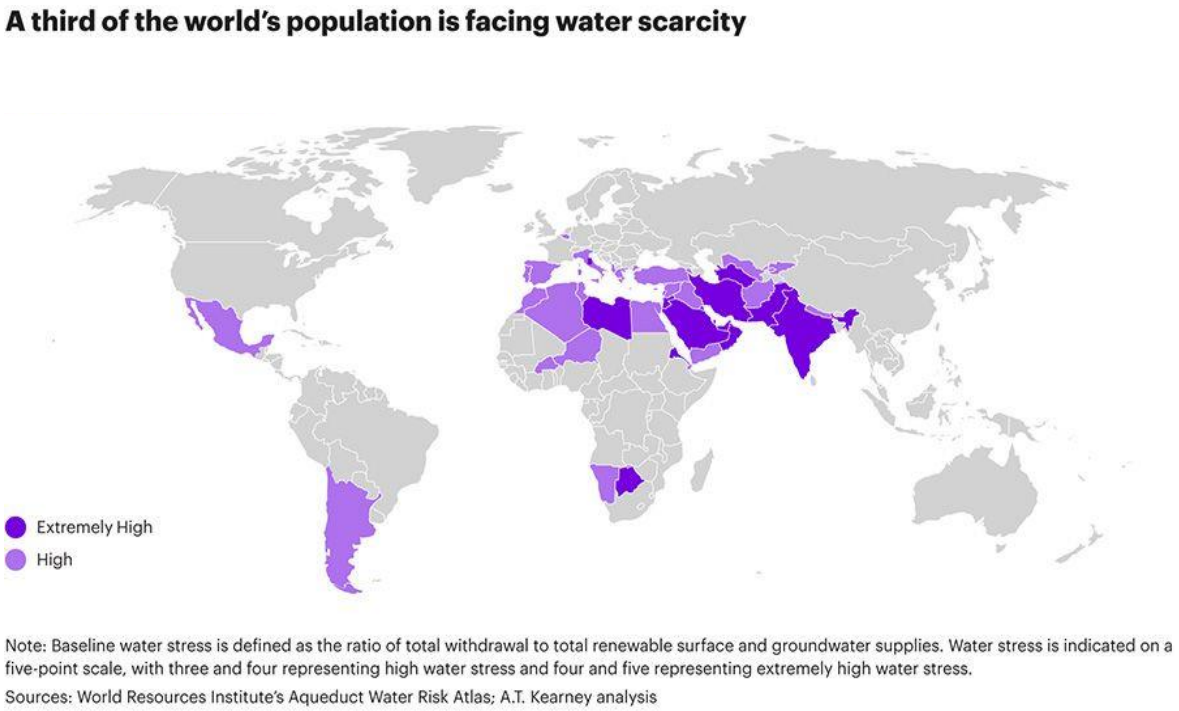

Figure 2-1: Global water scarcity situation (Source: Novo, 2020)

The figure above represents the baseline water stress across various countries of the globe. The impact of water stress is extremely high in some regions while high in other regions. The study by Piesse (2020) also showed that another aspect that needs to be reviewed is the concern that water resources are not evenly distributed, which results in scarcity in some parts of the world. Also, the use of water has more than tripled since the 1950s, increasing by more than twice the rate of population growth over that time as shown by Figure 2-2 below.

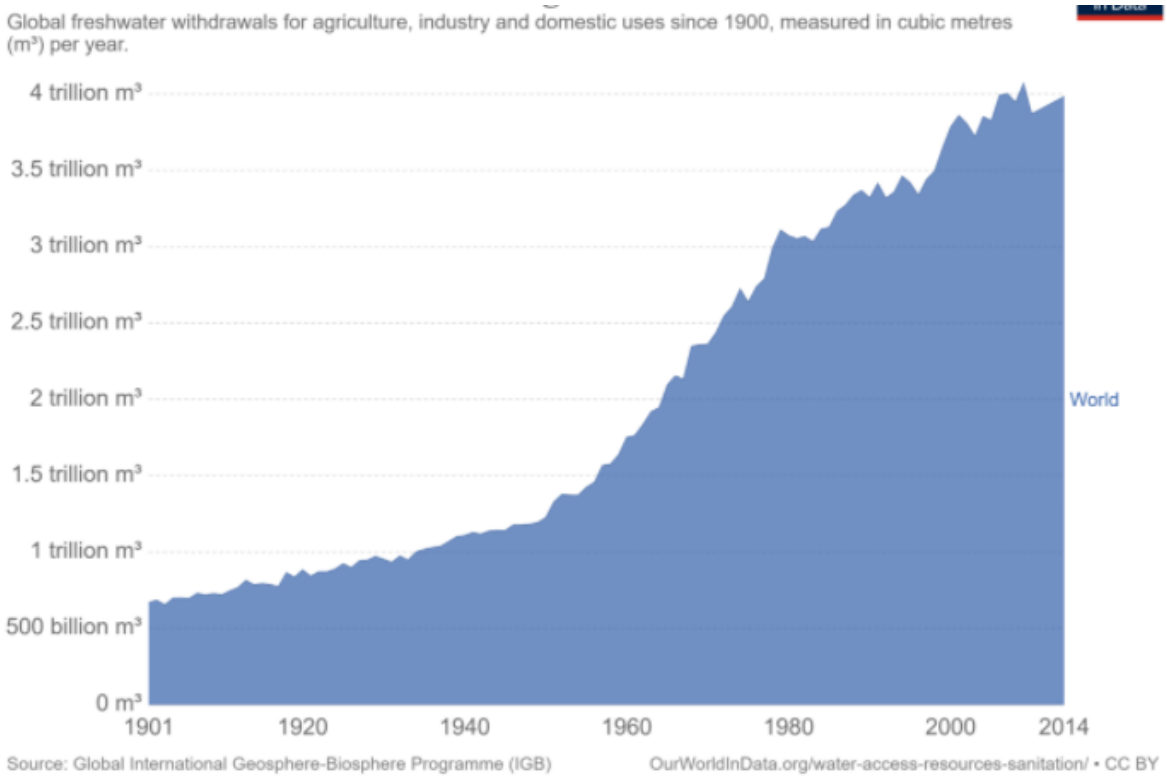

Figure 2-2: Global freshwater use over the long run (Source: Piesse, 2020)

As shown in Figure 2-3 above, yearly water consumption grew from 1.22 trillion cubic metres in 1950, to four trillion cubic metres in 2014 (Piesse, 2020). The organisation for economic cooperation and development (OECD) projects asserted that if water demand grows at a similar rate, it is possible that the world water consumption will grow to almost six trillion cubic metres by 2050 (Piesse, 2020). However, as the world population is anticipated to become more urbanised and wealthier over time, those predictions could underrate the scale of future water demand (Piesse, 2020). Regardless of the various ideas, initiatives and approaches to promote water-related innovations, efforts should be made to increase water conservation initiatives. In other words, policymakers should continue to follow up on these initiatives to avoid catastrophic water scenarios emanating from unpreparedness in the future.

Water conservation can be defined as a way of efficient and precise water use so that the needs of all ecosystems and living beings are met in a sustainable and permanent way (Loucks & van Beek, 2017). According to the Glossary of Environment Statistics, water conservation deals with the safeguarding, control and development of water resources, both surface and groundwater, and the prevention of water pollution (Environment Statistics, 1997). Fan, Wang, Liu, Yang and Qin (2014) outline that it can also be defined as those engagements and activities set out to minimise the demand for water, improve the efficiency of its use, and minimise losses and waste. A major reason for the conservation of water is to protect water resources and to achieve, at lower costs, the benefits from its use (Fan, et al., 2014). The decline in the availability of fresh water across the globe has resulted in robust debates, discourses and policy formulation (Cosgrove & Loucks, 2015). This decline in freshwater availability has also heightened the importance of water conservation globally, particularly in water-scarce regions (Cosgrove & Loucks, 2015). As Chavez, Ervin and Lindenmayer (2018) highlight, the growing demand for water has increasingly caused governmental and non-governmental entities across the globe to invest resources in water conservation.

Water usage for agriculture, industry and domestic use, amongst other sectors, has continuously reduced the volume of available water in several regions of the globe (Chavez, et al., 2018). Coupled with the effect of climate change, particularly in regions such as Southern Africa and Central Africa, water availability is continuously on the decline (Cosgrove & Loucks, 2015). Water scarcity in recent times is beginning to result in conflicts, of which one of such is the water-attributed conflicts between Egypt, Ethiopia and Sudan (Mbaku, 2020). Thus, multi-sectoral stakeholders across regions, countries and institutions are beginning to formulate water conservation strategies and policies towards the sustainability of fresh water, with consideration to protecting the hydrosphere; while meeting current and future water consumptions amongst all sectors (Mbaku, 2020).

Hence, a number of countries are beginning to employ advanced water conservation strategies not only to sustain their agricultural sector but to drive their industries and economy as a whole (Olayemi & Dorasamy, 2017). Invariably, the water conservation strategies used by specific countries are usually dependent on a number of factors, namely – rainfall pattern, climatic variation, level of technological advancement, types of crops cultivated and dominant soil type (Olayemi & Dorasamy, 2017).

2.3.2 Imperativeness of Water Conservation

Water conservation experts have often argued that water shortage will be the greatest challenge as water demand overtakes water supply in different regions of the globe (Hafif, 2016). Hence, it becomes imperative to conserve the limited water supply while avoiding wastage of this valuable resource.

The contamination of water sources through mining, industrial and agricultural activities, as highlighted by Ochieng, Seanego and Nkwonta (2010) exacerbates the water problem. This is largely safeguarded in South Africa via the national guideline for the discharge of effluent from land-based sources into the coastal environment. One of the benefits of water conservation is to some extent it counteracts the concerns that the rapid population increases, urban expansion, industrial development are concerns fast consuming the limited water resources (Ochieng, et al., 2010). People's negligence to use water the right way has adversely affected the replenishment of natural water and exacerbated the drought situation in different parts of the world (Kurunthachalam, 2014). At certain times, excessive use of water increases the pressure on septic and sewage units, which can result in groundwater contamination, thereby causing the non-treated or dirty water to migrate from the sewage system into the ground (Kurunthachalam, 2014). It is commonly known that many families spend money to access water in the city, which also means that the less water a household uses, the less they will pay for the billing period (Ochieng,

et al., 2010). Conversely, the more water a household uses the more the tariff that they will likely pay increases.

Figure 2-4: Importance of conserving water (Evans, 2020)

From the figure above, the importance of conserving water is further outlined below.

- **Conserving Water minimises the impacts of drought and water shortages**: Although the need for freshwater sources is growing due to population and industrial growth, the supply has remained constant (Evans, 2020). As much as the water ultimately returns to the earth through the usual water cycle, it does not return to the same spot and in the same quantity (Ditoro, 2016). Hence, there is better protection for future drought years by minimising the quantity of water that is used.

- **Protection against rising cost impact and political conflict**: Ignoring efforts to conserve water results in a lack of an adequate water supply, which may have negative consequences (Evans, 2020). Some of such demerits included rising costs, reduced supply of food, health hazards and political conflict (Ditoro, 2016).

- **Environmental preservation:** Decreasing the usage of water reduces the energy needed to process and transport it to homes, businesses, farms and communities, which assists in reducing pollution and preserving fuel resources (Ditoro, 2016).

- **Provides support for sustainable agriculture:** Conservation of water plays a major role in sustainable agriculture. Some of the cities and provinces that conserve water has planned made arrangements for better utilisation of water (Kurunthachalam, 2014). If most of an area's clean water is wasted, this will adversely affect future generations. Conservation of water resources should always be practised, not only during rainfall shortages but in all situations as water is a resource that cannot be produced (Evans, 2020).

2.3.3 Perceptions of Water Conservation

Perceptions regarding water conservation vary across the globe (Noga & Wolbring, 2013). Such perceptions on water conservation often vary between dry arid/desert regions of the middle eastern countries and regions such as Sri Lanka and the Democratic Republic of Congo that have abundant water resources (Noga & Wolbring, 2013). Due to the scarcity of water in arid regions of Israel, the population had to practice water conservation practices to sustain livelihoods (Weiss, 2019). Israeli water conservation practices have been ongoing for a number of decades. Hence, it has resulted in the positive perception of water conservation in Israel.

On the contrary, the majority of householders who reside in the Rural Development Programme (RDP) houses in communities such as Lamontville, specifically in a place called Emathinini, and KwaMashu, Inanda as well Welbedacht in Chatsworth, SA, are perceived to have a poor water conservation culture (Manomano & Tanga, 2018). These communities have been observed to waste water uncontrollably in a water-scarce country such as SA, as they are not billed for their water usage. Thus, in such communities, as mentioned above, awareness campaigns and other measures are required to redress this concern alongside other communities that do not have a positive perception regarding water conservation (Weiss, 2019). In line with the above remarks, it can be argued that a positive perception of water conservation can have negative consequences. On the contrary, a negative perception of water conservation can result in several adverse consequences (Noga & Wolbring, 2013). Adverse consequences include the impact on livelihood and the potential to affect the standard of living in the community.

Furthermore, Noga and Wolbring (2013) stress the needfulness of promoting a positive water conservative culture among households when they state that the most cost-effective way to reduce the demand for water, while sustaining the ecosystem is through sensitising the public on water conservative measures. Gholson, Boellstorff, Cummings, Wagner and Dozier (2019) opine that public perceptions and their corresponding behaviour over water issues are vital as to whether they adopt water conservation practices. Past studies have shown that such behaviours and perceptions are directly linked to how residents in a given area approach surrounding water use (Gholson, et al., 2019). This study was put together to evaluate the perceptions of Texas residents and their corresponding attitudes in the state. It also assessed the association of water quantity perceptions to water conservation actions. A positive perception regarding water resources is a key dynamic that influences water conservation. The findings from the study showed that these residents were concerned with the availability of water. It was further revealed that concerned citizens were more concerned with the availability of water and paid attention to water conservation practices (Gholson, et al., 2019).

More so, the needfulness of promoting a water conservation culture is imperative as available fresh water is fast declining globally. The declining fresh water is extensively used for agricultural, industrial and domestic purposes (Cosgrave & Loucks, 2015). The unprecedented world population also poses a great challenge to the limited fresh water. Researchers in the field of water conservation have made a series of arguments on the need to sensitise the public on water conservative issues (Cosgrave & Loucks, 2015). According to Dolnicar, Hurlimann and Grun (2012), it was affirmed that water conservation is an important natural resource, and also an integral part of long-term resource planning. In other words, stakeholders should work towards conserving this natural resource and plan strategically for the management of essential resources to drive adequate sustainability (Dolnicar, et al., 2012). Cook, Sharma and Gurung (2014) also revealed that campaigns on conservation often have an inverse effect on conservation behaviours, which directly impact water quantity and quality. Hence, findings for such studies can motivate users to improve water education and outreach programmes, leading to improved conservation (Cook, et al., 2014). It is worth mentioning also is that none of such studies focused on water conservation to understand the perception of farmers in the Umgababa area.

2.3.4 South African Legislative Framework on Water

Several of legislative frameworks have been enacted by the then Department of Water Affairs and Forestry, which was changed to the Department of Water Affairs in 2012. These legislations were mainly enacted to sustain water resources as a means to providing potable water to South African citizens and developing the agricultural, mining, industrial, tourism and manufacturing sectors (Department of Water and Sanitation, 2015, p. 12-13). Hence, this subsection will outline the main legislative framework on water and its importance.

The National Water Act (No 36 of 1998) aims to ensure efficiency and sustainability of water use; redress past imbalances with regard to access to water for all South

Africans, while reserving sufficient quantity for the sustainability of the ecosystem (Department of Water and Sanitation, 2015, p. 4-6)

South African water resources are overseen by the Water Services Act of 1997 and the National Water Act (NWA) of 1998. These Acts support each other and outline a framework that aids in sustainable water resource management, which also helps to improve and broaden service delivery. The NWA is based on the standard that water forms part of a unitary, interdependent water cycle, and should be directed under constant protocols. The NWA is made up of broad provisions for the security, use, development, conservation, management and control of South African water resources (Water and Forestry, 2004). The strategic objectives are stipulated in the National Water Resource Strategy (NWRS-DWAF 2004). The National Water Policy also states that the government “will have the right to allocate water to downstream countries (Namibia, Lesotho, Botswana) in preference to local water allocations”, and for transboundary basins, “the whole shared catchment will be the basis for decision making, particularly where more than two countries are involved”.

Water plays a critical role in every facet of life - public and private, at all levels from international waters to the household level (Cosgrove & Loucks, 2015). In addition, the role of water towards the natural environment, economies, food security, production and around policies cannot be overemphasized (Cosgrove & Loucks, 2015). The administering of water utilisation, the users and the cost of what is used is complicated and is the responsibility of the different bodies at the local, national and international levels (Evans, 2020).

The value of water and its significance in all facets of life makes it a highly politicised issue. It is essential such that lack of access and control over the use of it can be a fundamental cause for scarcity and shortage for households (Department of Water and Sanitation, 2015). The policy on water is outlined in the water policy. Such policies may be is usually documented or undocumented by the government on a departmental or a local government level, even though what is normally executed might be different from the published policy (Kurunthachalam, 2014, p. 2). This

assertion can be buttressed by the current circumstances in some rural communities of eThekwini, such as the Umnini area of Umgababa wherein some households do not have access to potable water (Johnson, 2017). Hence, this contravenes Section 27B of the South African constitution which stipulates that “every South African should have access to potable water”. The eThekwini Municipality’s waste management unit, Cleansing and Solid Waste, is responsible for ensuring that the waste sector is one of the most active in initiating actions that contribute towards a reduction in carbon emissions with the first landfill gas to electricity projects in Africa at two of its sites. (eThekwini Municipality 2014, p. 87; Department of Water and Sanitation 2016, p. 8-9; Department of Water Affairs 2011, p.17).

2.3.5 Nexus between Water Conservation and Livelihood

A variety of studies have been conducted on the relationship between water conservation and livelihood globally as well as within the South African context (Damkjaer & Taylor, 2017), which was also highlighted by Chesterman, Entwistle, Chambers, Liu, Agrawal and Brown (2019). A cogent point raised within these sources is the strong correlation between water conservation and livelihood (Chesterman, et al., 2019). This is particularly of great concern among rural areas who mainly depend on natural resources such as water for domestic purposes, tourism, farming and other non-agricultural uses (Chesterman, et al., 2019). Rural communities also depend on resources such as forestry natural wild fruits, vegetables and medicinal plants, just to mention three vital natural resources used within rural SA. This shows how important it is for rural communities to pay closer attention to their given resources and how they are managed, which is the core thinking behind this study that revolves around the perception of water conservation. A good perception of the importance of water conservation will improve better management of this resource, thus improving residential livelihood conditions.

Factors such as climate change, human activities and population increases have significantly affected the sustainability of these resources (Samaneh & Haddad, 2018). For instance, the erratic rainfall, drought, deforestation and wildfires can be partly attributed to the impact of climate change as highlighted by Abdullahi, Suresh, Renukappa and Oloke (2017). Thus, in many regions across the globe, natural resources are depleting due to unsustainable practices (Abdullahi, et al., 2017). There is evidence of depletion of natural resources in SA and across the globe. Connolly-Boutin and Smith (2016) state that such depletion has heavily impacted the livelihoods of the poor, particularly those who reside in rural communities and solely depend on resources such as rainfall to sustain their crops and livestock. Water, in particular, is significantly scarce amongst rural farming communities of SA, particularly during the winter months which falls between April and July (Connolly-Boutin & Smit, 2016). Many of these rural farming communities receive very little rainfall. Hence, water scarcity adversely impacts their livestock, farming and other agricultural activities (Connolly-Boutin & Smit, 2016).

This invariably means that water conservation might be their only coping mechanism to adjust to water scarcity during the dry season or in circumstances whereby they do not have an alternate water source in close proximity. Thus, this emphasises the imperativeness of water conservation in such communities, thus water conservation practices have a strong relationship with livelihoods among these rural communities. As highlighted by Sinclair-Smith and Winter, a very strong water conservation mechanism adopted by a community has a positive relationship with or effect on the livelihood of the community (Sinclair-Smith & Winter, 2019).

2.4 WATER SCARCITY: IMPORTANCE OF WATER CONSERVATION TO RURAL FARMERS

This sub-section serves as a continuity to an earlier section (2.2). In this subsection, the narrative is centred on themes such as water conservation and adaptability in

rural South Africa and the role of water within rural communities of South Africa and elsewhere, amongst other important discourses.

2.4.1 Water Conservation and Adaptability in Rural South Africa

Rural communities across the globe often are dependent on natural resources in their communities (Lamula, 2014). However, industrialisation, intense farming activities, climate change, urbanisation, over-extraction of groundwater, mining activities and deforestation has significantly depleted natural resources over the years (Misra, 2014). According to Chakravarty, Ghosh, Suresh, Dey and Shukla (2012), this depletion of natural resources has significantly worsened livelihoods amongst several rural communities. Due to these, rural communities have had to adapt by using several adaptable approaches to obtain water particularly for domestic and farming purposes (Chakravarty, et al., 2012). More particularly, due to the insufficiency of water, the rural populaces have often had to use water conservative techniques to sustain their crops and livestock during the rainy and dry seasons (Molobela & Sinha, 2012). However, due to the unprecedented level of depletion of natural resources, the unbearable circumstance has often resulted in the migration of rural community members to urban communities. This has been the case as their previous fertile land has turned infertile, thus making their livelihoods difficult (Olayemi & Dorasamy, 2017, p. 66). In line with these challenges, water conservation and adaptability measures are considered essential, particularly in rural communities such as the area under study which is the Umgababa community.

2.4.2 Role of Water in Rural South Africa

According to Botai, Botai and Adeola (2018), SA is a semi-arid, water stressed-country, with an average rainfall of about 450 mm. According to Hove, D'Ambruoso, Mabetha, van der Merwe, Byass, Kahn, Khosa, Witter and Twine (2019), the government of SA invested 15 billion rands in infrastructure between 1994 and 2004. This water stress is mostly felt by the rural community of SA, who often lack

access to adequate potable water for domestic, agricultural, or other purposes (Botai, et al., 2018). The importance of water in rural South Africa cannot be underestimated as water is directly linked to every facet of their livelihood (Mothetha, Nkuna and Mema, 2013). The execution of some projects was halted due to the insufficient supply of water, thus indicating that viable development projects depend on a steady supply of water (Bakre & Dorasamy, 2015). Studies conducted by Mothetha et. al (2013) affirm that the insufficiency of water in rural communities has resulted a number of negative consequences on rural livelihoods. Amongst these consequences are cyclical poverty, food insecurity as well as health-related concerns. These consequences are imminent in the community of Umnini area of Umgababa, which are yet to have access to sufficient water for domestic, agricultural, or tourism use (eThekwini Municipality, 2021). Previous research on poverty evaluation revealed the association between the availability of sufficient water and agricultural development in rural areas (Bakre & Dorasamy, 2015). For instance, improvements around the steady supply of water play a pivotal role in developing and executing operative and capable strategies for poverty mitigation (Bakre & Dorasamy, 2015).

The role of water in the rural settlements in South Africa is pivotal as the absence of water poses significant threats to well-being and survival (Hove, et al., 2019). Preventable infectious illnesses, waterborne diseases, cholera, typhoid and other intestinal sicknesses were associated with the shortage of water (Hove, et al., 2019). More importantly and in line with this study, the absence of water negatively affects household farming activities, which ultimately impacts economic transactions in the community, thus affecting livelihoods. Another side effect of such absence is that farmers will likely be demoralised, as their means of feeding their families will be affected. This goes on to show the vital role that water plays in the rural communities of SA and how farming activity can be affected, especially in the Umgababa community.

2.4.3 Water Conservation and Adaptability in Rural South Africa

As highlighted by Abdelhak, Sulaiman and Mohd (2011), rural communities across the globe often are dependent on natural resources in their communities. However, industrialisation, intense farming activities, climate change, urbanisation, over-extraction of groundwater, mining activities and deforestation has significantly depleted natural resources over the years (Misra, 2014, p. 55). This depletion of natural resources has significantly worsened livelihoods amongst several rural communities (Chakravarty, et al., 2012, p. 5). Due to this, rural communities have had to adapt by using a number of adaptable approaches to obtain water particularly for domestic and farming purposes (Abdelhak, et al., 2011). More particularly, due to the insufficiency of water, the rural population have often had to use water conservative techniques to sustain their crops and livestock during the rainy and dry seasons (Mothetha, Nkuna and Mema, 2013). However, due to the unprecedented level of depletion of natural resources, the unbearable circumstance has often resulted in the migration of the rural community members to urban communities because their previous fertile land has turned infertile, thus making their livelihoods difficult (Molobela & Sinha, 2012, p. 5). In line with these challenges, water conservation and adaptability measures are considered to be essential, particularly in rural communities such as the area under study.

2.4.4 Sustainable and Adaptable Water Conservative Techniques

Local farmers make use of diverse types of water conservation methods. Again, the climatic situation, degree of water technology in a specific farming community, nature of the soil, rainfall volumes and the kinds of crops that are cultivated influence the choice of the technique applied (Sawadogo, 2011). More than half of the land surface in Israel is made up of arid and desert land, which is usually unfavourable for crop production (Sawadogo, 2011). Even though they are faced with such unfavourable conditions, Israel is still one of the global leaders in the arena of agricultural production and associated research (Tal, 2008). Their frontline position

in agriculture has always been a function of decades of research and application of valuable policies that apply to sustainable water resource management (Futran, 2013). This shows that countries like SA and other economies that face water-scarce situations can adopt certain successful values, which can help them to accelerate agricultural development and poverty reduction. Developed countries like the Germany, China, the United States of America, and Indonesia have leveraged some of these agricultural advancements made by Israel, to arrive at highly sophisticated water conservation techniques that will help their local agricultural programme (Johnson, 2017). For instance, some of such sophisticated irrigation technology, for example, managed deficit irrigation and scientific irrigation, reduced evaporation, rainwater catchment from high tunnels, tail water return systems, and improved furrows, just to mention a few.

Many viable employment opportunities due to the tremendously increased production output in agriculture, have enhanced the standards of living in addition to Israel's agricultural next export (Water Europe, 2013). However, many underdeveloped and developing nations as highlighted by Kanu, Salami and Numasawa (2014) cannot adopt these thoughtful creativities and inventions due to financial restraints, shortage of skills, and weak infrastructure. Just like Israel, , numerous, diverse developments and more studies have also been carried out towards the management of water resources in India (Kanu, et al., 2014).

During the dry season as highlighted by Wolka, Mulder and Biazin (2018), many subsistence farmers in India have embraced different methods in keeping the production of crops. A very common method is known as the "percolation tank" (Wolka, et al., 2018). Under this method, the farmers trap rainfall water via the use of a reservoir that helps to hold the water in shallow water tables. After this, the accumulated water from this process is transferred onto the farmlands when needed (Wolka, et al., 2018). In addition, many soil fertility investments in India have assisted in enhancing the management of water. An experiment regarding the use of water management that was performed around 300 villages in India and showed

a negative effect that occurred because of subsistence farming approach (Wolka, et al., 2018). The findings from the study revealed that subsistence farming eroded soil nutrients, thus affecting farm produce sustainability. In a bid to increase subsistence agricultural methods in these communities, acceptable nitrogen and phosphorus were utilised, which increased some crop outputs.

Also, the micronutrient amendment net economic proceeds were 1.5 to 1.75 times higher. According to Jat, Wani and Sahrawat (2012), there were noteworthy advances when joint land and water management choices were embraced, in addition to the use of better-quality cultivars in semi-arid areas of India. A complete review of 311 cases relating to crisis programmes in India was based on the management of water resources and uncovered that the average cost-benefit proportion of crisis programmes was fairly high. This led to better living standards across rural communities that still follow subsistence farming; creating new employment prospects; expansion of watered zones and the safeguarding of soil and water resources (Jat, et al., 2012).

Jat et al. (2012), outlined that water conservation management is vital to addressing rural poverty in Southern Africa, in countries like Malawi and Mozambique. This stance is based on the expansion, as well as the progression of numerous farming communities, which are inhibited by the unsatisfactory water supply for their crops and livestock**.** In acknowledgement of the situation this region faces, the International Fund for Agricultural Development (IFAD 2012) has incorporated among its four major ‘thrusts’, actions targeted at “improving access to and management of land and water”, as vital aspects of dealing with poverty; optimising food production and improving the living standard in the area. Additionally, the New Partnership for Africa's Development (NEPAD 2009: NEPAD 2011), in its Comprehensive Africa Agriculture Development Programme (CAADP), has suggested that a dependable water control system that is focused on small-scale control of water be put in place. The intent is to enhance the fertility of the soil and water-holding capacity of agricultural soils and expand irrigation as one of three

pillars that can lead to notable progress in Africa's agricultural development. Based on this proposition, the water management of smallholder agriculture was the focus of the Millennium Development Goals on hunger. This is also believed to be a means of multiplying food security and eliminating poverty among poorer residents in sub-Saharan Africa (Sawadogo, 2011).

Jabali, Okhravi, Eslamian and Gohari (2017) highlighted that subsistence farmers in sub-Saharan Africa, with their equals in arid Asian farmlands have also been ambitious to develop their crops on abandoned farmlands for years. The method of water conservation applied by subsistence farmers are directed at enhancing land and water management practices to minimise soil erosion; catch more rainfall; increase the organic soil conditions; and refill the necessary nutrients (Jabali, et al., 2017).

As highlighted by Abdul-Han, Ayamga and Donkoh (2014), these tactics have impacted the sustainability of crops, while minimising the effect on the environment through agriculture. For example, farmers in Burkina Faso and Niger have accepted these conservation practices known as Zai. This technique is engineered by setting up stone lines and improving the planting pits (Abdul-Hanan, et al., 2014). These regional farmers have successfully trapped rainfall on crop farms, such that they improved farm yields from a range of 400 to 900 kilograms per hectare (kg/ha) through this technique (Jabali, et al., 2017). Additionally, these West African subsistence farmers have utilised the united soil fertility management by using residue from crops, old compost, mulch, manure from livestock, leaves and fertiliser. These methods have led to subsistence farming improvements and positively changed the standards of living in the region, as providing fresh nutrients for the sustainability of the crops is no longer a problem (Krois & Schulte, 2014). These methods also help soil organic matter restoration and general fertility condition of the soil, which adds to sustainable amplification of crop produce (Jabali, et al., 2017). Smallholder farmers in developed nations use the following water conservation techniques:

a. **Mulching:** Mulching can be defined as the covering of the soil between plants with a layer of material, which keeps roots and bulbs cool in the summer season and warm in winter (Department of Agriculture, 2014). As highlighted by Wambede, Ebifa, Asaba and Claire (2019), mulch is primarily used to maintain moisture in the soil. It was also stated that they support infiltration of runoff and irrigation water because they protect the soil from the impact of raindrops, thereby keeping the moisture in the soil for a long period (Wambede, et al., 2019). Mulching inhibits the evaporation of water, therefore, less watering is required as it shields the soil from wind, rain and sun (Department of Agriculture, 2014).

b. **Reservoir/Valley Dam:** An artificial lake is created by building a dam to store water (Nissen-Petersen, 2006). This is usually built by excavating a depression of the water reservoir and depositing the excavated soil on the lower side of the water, which will increase the shortage volume of the excavated water reservoir (Department of Agriculture, 2014).

c. **Terracing:** This is a method of farming that involves the construction of platforms along a slope. This method of water conservation is normally applied by farmers who have plots of land on the upper slope segments (Wambede, et al., 2019).

d. **Tied Ridge:** This is considered to be a major dominant technology utilised on the upper slope segments (Wambede, et al., 2019).

Subsistence farmers have embraced many water conservation methods to sustain their crops in Southern African countries such as Malawi and Mozambique. Among these methods is the planting of Faidherbia albida trees on their farms using modest quantities of fertiliser (Wambede, et al., 2019). Jabali et al. (2017) opine that these

plants minimise the intensity of the sun, as they provide shelter and trap nitrogen inside the soil. Subsistence farmers who applied this technique have observed their maize produce rise from one tonne per hectare to three and four tonnes per hectare. As highlighted by Sawadogo (2011), adequate management of water resources will support subsistence farming and promote poverty reduction in rural communities. One of the reasons the SADC region loses opportunities to expand food security and multiply the income of households is directly influenced by the ineffective management of water resources (Sawadogo, 2011). In addition, there are publications and literature which show that some of these water conservation techniques are known and have previously been used (Abdul-Hanan, et al., 2014). As shown in this literature review, appropriate and effective use of water resources play an integral role in subsistence farming. In essence, little awareness exists as to how the knowledge of water resource management among irrigators influence the behaviour and practice of smallholder farmers (Oremo, Mulwa and Oguge, 2019).

In SA, a good number of the smallholder irrigation initiatives do not have sufficient involvement of the farmers and lack the necessary knowledge to efficiently sustain irrigation infrastructure towards good water conservation (Agholor & Mzwakhe, 2020). Even though substantial progress has been made nationally in the water sector, post-apartheid, it still falls short of the required water conservation approach to sustainable farming by smallholder farmers. As previously stated, the proper management of water resources and applicable techniques in Southern Africa will fuel the development of subsistence farming that will contribute immensely to rural poverty alleviation (Sawadogo, 2011). Hence, there is a need to increase the education and awareness of rural farmers towards water conservation. In addition, adequate action plans are required to make progress in this regard for further water conservation outcomes that are sustainable. Furthermore, Oremo et al. (2019) indicated that farmers who possess a better knowledge of water conservation management are usually more educated, richer, belong to a local farmers' network and are involved in agricultural extension services. Therefore, the study by Oremo

et al. (2019) encourages smallholder farmers to be involved in agricultural extension services, as this will increase their knowledge on water management and conservation practices (Oremo, et al., 2019). However, these studies have not covered the perception of farmers on water conservation practices that would be adequate for the Umgababa community.

2.4.5 Perception of water Conservation

Perceptions regarding water conservation vary across regions of the globe (Attari, 2014). Such perceptions of water conservation often vary between dry arid/desert regions of the middle eastern countries in comparison to regions such as Sri Lanka and the Democratic Republic of Congo that have abundant water resources. According to Marin, Tal, Yeres and Ringskog (2017), due to the scarcity of water in arid regions of Israel, the Israeli populace has to practice water conservation in order to sustain their livelihoods. These water conservation practices have been ongoing in Israel for several decades (Marin, et al., 2017). Hence, it has resulted in a positive perception of water conservation in Israel.

On the contrary, most of householders who reside in RDP houses in communities such as Lamontville, specifically in a place called Emathinini, and KwaMashu, Inanda and the Welbedacht community of Chatsworth in South Africa are perceived to have a poor water conservative culture (Manomano & Tanga, 2018). These communities have been observed to waste an insurmountable amount of water in a water threatened country like South Africa, as they are not billed for their water usage (Manomano & Tanga, 2018). Thus, in such communities, as mentioned above, awareness campaigns and other measures are required to redress this concern alongside other communities that do not have a positive perception regarding water conservation. In line with the above remarks, it can be argued that a positive perception of water conservation can have inverse consequences. On the contrary, a negative perception of water conservation can result in several adverse

consequences. Such adverse consequences may impact livelihoods and poverty (Attari, 2014).

Marin, Tal, Yeres and Ringskog (2017) stress the necessity of promoting a positive water conservative culture amongst households. The most cost-effective way to reduce the demand for water, while sustaining the ecosystem is through sensitising people on water conservative measures (Marin, et al., 2017).

More so, the needfulness of promoting a water conservation culture is imperative as available fresh water is fast declining globally. The declining fresh water has also been extensively used for agricultural, industrial and domestic purposes (Attari, 2014). The unprecedented world population also poses a great challenge to limited fresh water. Researchers in the field of water conservation have made a series of proposals on the need to sensitise the public on water conservative issues (Manomano & Tanga, 2018). Dolnicar, Hurlimann and Grun (2012) affirm that water conservation is an important natural resource and an integral part of long-term resource planning. Additionally, more studies revealed that campaigns on conservation often have a positive effect on conservation behaviours, which directly impacts water quantity and quality (Dolnicar, et al., 2012). As highlighted by Moglia, Cook and Tapsuwan (2018), a review of water conservation initiatives has also shown that roadshows and campaigns increase public awareness and help in driving good water conservation cultures. However, it is important to target a long-term focus over such campaigns as the results are not always immediate (Moglia, et al., 2018). Hence, findings for such studies can motivate users to improve water education and outreach programmes, leading to improved conservation. Another fact worth mentioning is that none of the studies focused on water conservation that has been previously conducted in the farming community of Umgababa.

2.4.6 Small Scale vs Large Scale Farmers

The policies targeted at controlling and zoning land for particular uses are influenced by the nationwide goals for agricultural and natural resource-based economic development, in which granting state land leases and concessions for land and forest resources to private investors have become a cornerstone (Carver, 2012).

The Sustainable Development Goals (SDGs) of 2015 have driven the expansion of community to focus on improving livelihoods and climate resilience for small-scale farms (Sustainable Development Goals, 2015). Confronting water scarcity in small-scale farming systems remains a high priority for organisational building, researchers and donors. As precipitation trends remain dynamic with climate change, the livelihoods of small-scale farmers who have limited water access and technologies will become even more marginalised (Carver, 2012). According to Lowder, Skoet and Raney (2016), small-scale farmers represent more than 80% of the world's farms and are major contributors to the food system. Also, farms of less than five hectares produce nearly 50% of the global food supply (Lowder, et al., 2016).

In comparison to small-scale farmers, the increased yield benefit seems to be not that important to large-scale farmers. Although more than 50% of large-scale farmers indicated increased yield as a benefit, it is seen more as a bonus (Carver, 2012). Wang, Cardon, Liu and Madni (2020) opine that enhanced access to water and efficient use are known to optimise yields and farmers' income, but solutions that are efficacious in one area might not work elsewhere. Some of such solutions like water harvesting, soil enhancement tactics, drought-resistant crops and choice of livestock breed are dissimilar, and their effects can change across physical, social and political dimensions (Wang, et al., 2020).

These are some of the things that quantify the way irrigations are implemented for farmers in various regions (Lowder, et al., 2016). Therefore, it is essential for funders and researchers to pay attention to water-scarce areas with the biggest differences towards the right to use critical resources such as irrigation, and the minimum extent

of evidence for the effectiveness of on-farm interventions on farm yields and livelihoods. Results are limited by the fact that this study focuses on irrigation coverage challenges faced by small-scale farmers.

However, upcoming investigations can expand our techniques to inspect other types of marginalisation, such as poor soil quality, travelling distance to markets, climate exposure, land use and land tenure. This will assist in prioritising funding towards evidence-backed interventions for disadvantaged small-scale farming.

2.4.7 Water Conservation Techniques used among South African farmers

Population growth, the movement of rural settlers to urban centres, and urbanisation resulted in increased demand for water resources and the promotion of water conservation (Cosgrave & Loucks, 2015). Although agriculture remains the biggest user of the world's water resources, more than 25% of energy spent globally relates to food production (United Nations, 2021).

The increasing scarcity of water resources is the highest threat towards the realisation of the 2030 Agenda of the Sustainable Development Goals (SDGs) (United Nations Report, 2015). According to Nhemachena, Nhamo, Matchaya, Nhemachena, Muchara, Karuaihe and Mpandeli (2020), water shortages present serious problems to sustainable agricultural development. However, if managed effectively can increase resilience to social, economic and environmental issues resulting from climate event.

A foremost concern is the dilapidation of land and water resources which eventually jeopardizes the sustainability of the environment and agriculture in SA (Nhemachena, et al., 2020). Ignoring essential water conservation practices is that it will lead to food shortages and loss of farm income. During this period of unpredictable climate occurrences, sustainable water conservation techniques is now a national development policy discourse for SA, notably as an avenue to mitigate the anticipated food insecurity disaster (Agholor & Mzwakhe, 2020).

Some of the practices after adopting water conservation practices include mulching, rainwater harvesting, contour ridges and terraces must form part of the development initiatives for agriculture in the study area (Agholor & Mzwakhe, 2020). Nevertheless, farmers face diverse limitations such as the unsteady agricultural guidelines, scanty knowledge of known conservation practices and inadequate research to justify the use of a particular conservation practice (Nhemachena, et al., 2020). Furthermore, the adoption of water conservation practice remains indeterminate and low in most communities (Nhemachena, et al., 2020), despite concerted efforts to encourage farmers in South Africa. The rest of this sub-section summarises some of the most used water conservation practices in South Africa.

Shift cultivation: According to Mnkeni, Chiduza, Modi, Stevens, Monde, van der Stoep and Dladla (2010 p. 65), this practice encompasses a scenario where the farmer does not plant or plough the land over a duration, in a bid to improve the fertility of the soil.

Rainwater harvesting: This is a method where farmers source water directly from roof surfaces, the ground, rocks and other watertight surfaces via rain (International Water Management Institute , 2006). In addition, the harvested water is stowed in structures like tanks, dams and rock catchments to supply water for agricultural and domestic use.

Planting Without Ploughing (PWP): Planting Without Ploughing (PWP) as explained by Bakre and Dorasamy (2017), is a practice whereby farmers intentionally plant seeds or crops on fallow land. The soil moisture is preserved as the farmers do not remove the weeds and other unwanted crops on the ground. Therefore, the PWP is a practice that ensures soil fertility and is ideal for sustainability.

Soil and water conservation (mulching): The practice of mulching is realised by putting crop remains and grasses on the soil surface in a nurtured field, to conserve moisture, decrease runoff flows and improve soil fertility (Mnkeni, et al., 2010).

The next subsection provides an applicable framework to water conservation and rural farming.

2.5 CONCEPTUAL FRAMEWORK

According to Adom, Hussein and Agyem (2018), conceptual and theoretical frameworks are usually essential because they explain the route of research and establishes it decisively in theoretical constructs. The entire goal of both contexts is to ensure that research findings are more significant, adequate for the theoretical constructs in the research field and guarantees generalisability (Adom, et al., 2018). In simpler words, the conceptual framework outlines how the research problem would be explored.

As revealed by Cohn, Newton, Gil, Kuhl, Samberg, Ricciardi, Manly and Northrop (2017), the adoption of water conservation among small-scale farmers in South Africa is still low when compared to farmers in countries such as Israel and India. Despite the proven economic and environmental benefits of water conservation to farming, South African farmers are yet to fully exploit this stratagem (Cohn, et al., 2017). This study was conducted in a small community of Umnini in the Umgababa area. The purpose of the study is to investigate the perception of water conservation among this farming community.

This subsection provides a framework to comprehend farmers' perceptions regarding the environment. The operational and geographical environments influence the perceptual environment. This also affects their outcome of experience, recollection, the definition of the environment and changes, and prospects of future change (Abdul-Hanan, et al., 2014). The perceptual environment is also facilitated by community-held values and beliefs, in addition to the cultural context. The operational and geographical environments go via the perceptual environment to shape intent (to act) and finally a behavioural outcome (which can be no action, coping, or adaptation) (Olayemi & Dorasamy, 2017).

Kalcic, Prokopy, Frankenberger and Chaubey (2014) explain that to compare the perceptions of high adopters versus that of low adopters, farmers may be assembled based on the acceptance of conservation practices from high level to low level implementers. Each of these practices chosen to evaluate conservation adoption will determine if it had been implemented by at least a few farmers (Kalcic, et al., 2014). Conservation adoption criteria were developed to define the adoption of a given practice so that results could be reported consistently across all the farmers of the Umgababa community.

The attitude of farmers depicts the individual's opinions by estimating whether they will be positive or negative. Therefore, people, having encouraging attitudes will have a greater intention toward this behaviour (Abdul-Hanan, et al., 2014). For instance, the attitude of farmers has been classified as having a significant positive relationship regarding the intention to improve natural grassland (Loucks & van Beek, 2017). In the same way, a study in Cabo Delgado (Northern Mozambique) as described by Lalani, Dorward, Kassam and Dambiro (2017), revealed that the highest level of significance for farmers' attitudes toward their intention to carry out conservation agriculture was quite significant. Moreover, numerous results from researchers, such as (Lalani, et al., 2017) confirmed that the attitude of farmers is a significant factor related to the intention of the farmers' behaviour.

Thus, the model illustrated in Figure 2-4 below is drawn in cognizance of the study's aim and objectives which were introduced at the inception of this study:

- To identify the water conservation techniques used in the Umgababa community;
- To determine if the water conservation methods used are adaptable;
- To determine the extent of adaptability of the water conservation techniques used in the Umgababa community, and
- To recommend guidelines towards sustainable water conservation techniques.

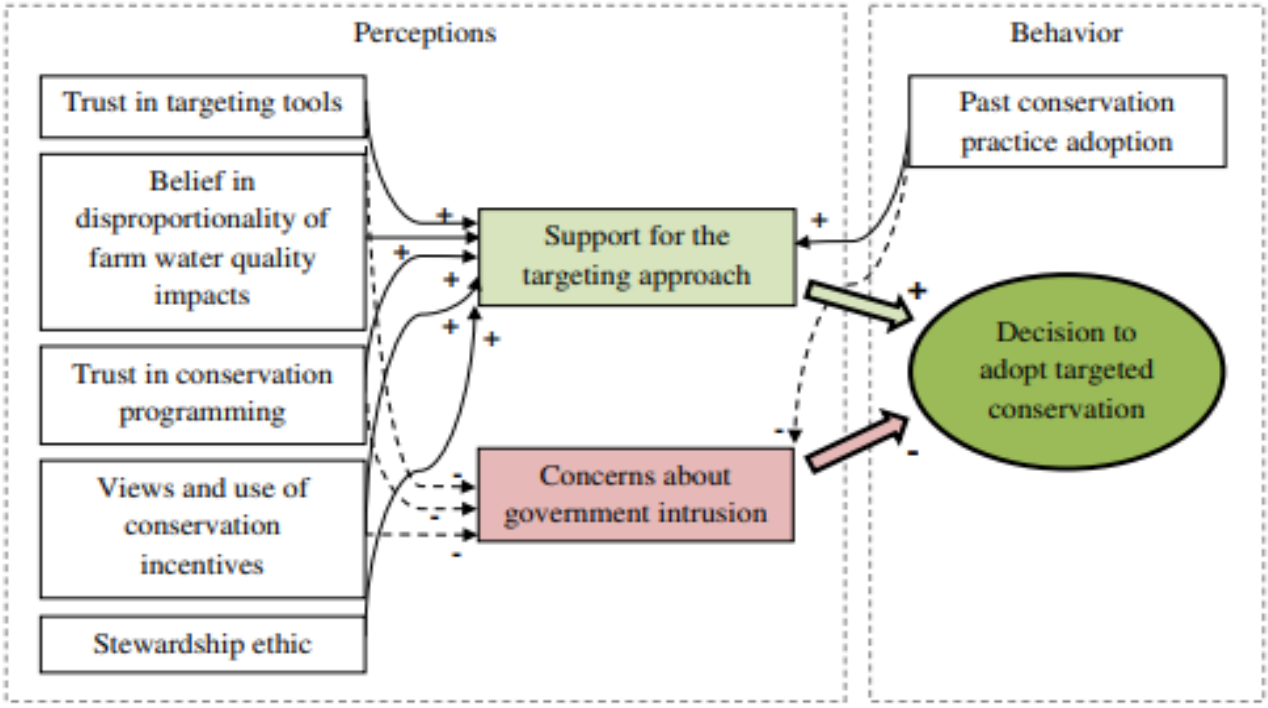

Figure 2- 5: Model on Water Conservation (Source: Kalcic et al., 2014)

Figure 2.4 above illustrates the perception and behavioural trends of water conservation. From this model, two concerns are paramount regarding the perception of water conservation. These are support for the targeting approach and concerns about government intrusion. More so, the model highlights 'past conservation practice adoption' as a factor that could influence behaviour on water conservation (Kalcic, et al., 2014). This model is applicable to the current study, as it unequivocally highlights water conservation, within the scope of the study's aim and objectives.

With regards to water scarcity and climate variability, behavioural outcomes can vary from no response to coping and to adopting as highlighted by Singh, Osbahr and Dorward (2018). While (Singh, et al., 2018) have already expanded on the relationship between behaviour and value, culture, knowledge and beliefs for this

study location, they highlight the need to improve insight between these factors and the effects of risk perceptions from other aspects within the perceptual environment.

This is important because being mutable and value-laden, perceptions may attribute phenomena to wrong causal factors (Salite, 2019). However, wrong perceptions do not imply good or bad judgement but highlight that perceptions may not necessarily reflect actual data and result in misattributions (Singh, et al., 2018). In fact, in the 'perception approach', the superiority of the 'expert viewpoint' and is questioned, with each opinion having its own validity is questioned with no one 'right' response to a hazard (Salite, 2019).

According to Ntshangase, Muroyiwa and Sibanda (2018), there are some reasons why farmers may embrace a new farming technology. Some farmers may be rational in their behaviour and their perceptions may be influenced by the information available to them, their socioeconomic situation and farm enterprises (Ntshangase, et al., 2018).

2.6 CONCLUSION

This chapter presented the literature review, which explained the looming water scarcity within the global context. It further outlined the repercussion of water scarcity and the imperativeness of water conservation. Even though water conservation is needful in a variety of sectors; the focus in this chapter was the significance of water conservation amongst rural farmers. Thus, the latter sections of this study explore this theme and other relevant themes. The next chapter presents the research methodology.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 INTRODUCTION

The previous chapter discussed the literature overview, while this chapter deals with the research methodology and study design. The chapter outlines the research design, research strategy and research philosophy. This chapter also provides the rationale for the selected research design, research philosophy and research strategy. This chapter also discusses the target population, sampling strategies, approach to data collection, data analysis, trustworthiness and ethical considerations.

3.2 STUDY OBJECTIVES

The study objectives were identified to achieve the aim of the study:

- To identify the water conservation techniques used in the Umgababa community;
- To determine if the water conservation methods used are adaptable;
- To determine the extent of adaptability of the water conservation techniques used in the Umgababa community, and
- To recommend guidelines towards sustainable water conservation techniques.

3.3 RESEARCH DESIGN

Research design is defined as an arranged blueprint that directs the researcher in a precise manner (Dinnen, 2014). Wilson (2013, p. 21) defined a research design as a comprehensive overview of how an investigation will take place. It elucidates the type of data collection to be utilised in gathering information necessary to address the research problem, whilst fulfilling the research objectives (Wilson,

2013). The research design also deals with a systematic plan of the data collection and analysis aspects of a project (Wilson, 2013). Another role of the research design is to make sure that the outcome extracted from the study helps the researcher to adequately handle the research problem in a more simplified manner (Creswell & Creswell, 2018). The vital qualities of a research design include neutrality, reliability, validity and generalisation (Creswell & Creswell, 2018). Research design can further be broken down into various types. These are descriptive, experimental, correlational, diagnostic and explanatory research designs (Sekaran & Bougie, 2013).

The descriptive research design is theory-based that is designed by gathering, analysing, and presenting collected data. It also utilises the characteristics of the population and follows the descriptive research method, which qualifies the use of the quantitative method (Wilson, 2013). On the contrary, exploratory research design focuses on exploring a phenomenon, thus utilises the qualitative method (Bhat, 2017).

3.4 RESEARCH METHODOLOGY

Even though the research design deals with an arranged blueprint that directs the researcher in a precise manner, the research methodology is an orderly pattern that guides the scholar in a specific direction (Dinnen, 2014). A clearer comprehension of the research method helps the researcher to appropriately focus on the course of the study, thereby enabling the researcher to conserve time and other vital resources (Creswell & Creswell, 2018). Another view explains the research method as a methodical and logical tactic that is followed to the gather and analyse data to ensure that beneficial information can be extracted (Kilani & Kobziev, 2016). The two major types of research methods are quantitative and qualitative methods.

3.4.1 Quantitative Method

This method is considered to be an extreme form of observation because it relies on the control and explanation of the occurrence (Kilani & Kobziev, 2016). The quantitative research method usually deals with occurrence, frequency of occurrence and the extent to which it happens. Hence, the quantitative method is focused on arriving at the truth. Quantitative research often applies the deductive approach, which means that data is collected to examine a known theory or principle. This type of method utilises descriptive and inferential statistics to assess data obtained from the research instrument to help the researcher arrive at a vital conclusion (Sekaran & Bougie, 2013). According to Saunders, Lewis and Thornhill (2012), because of the possible population size required for the study, the data collection means, and approach can be expensive, and the rate of response or feedback is sometimes deemed low. In addition, this research method studies the link that occurs between variables via numerical assessment and is usually done using survey forms and questionnaires (Sekaran & Bougie, 2013).

3.4.2 Qualitative Method

The qualitative research method supports the view that the entire globe is multifaceted and not simplified via theories (Saunders, et al., 2012). This type of method suggests that social sciences differ from natural sciences, which needs the understanding of a person in contrast to scientific explanation (Saunders, et al., 2012). Another view of the qualitative method is that it is dependent on actual life scenarios, such as the experiences and actions of other people (Kilani & Kobziev, 2016). It also uses a subjective sampling method which is not generic in approach but is normally faster relative to the quantitative method (Kilani & Kobziev, 2016). The outcome of the data and information from qualitative research is usually in words, sentences and narration as opposed to data (Kivunja & Kuyini, 2017). However, it is important to note that the qualitative research method has a higher

probability of bias and providing summaries easily from qualitative data is challenging (Crossman, 2019).

3.4.3 Mixed Method

According to Shorten and Smith (2017), the mixed method provides a situation where the scholar gathers and analyses both quantitative and qualitative data in the same study. This type of research method leverages the good qualities of the quantitative and qualitative methods, hence enabling the researcher to discover various viewpoints that will benefit a given study (Shorten & Smith, 2017). According to Timans, Wouters and Heilbron (2019), combining quantitative and qualitative research methods help in amplifying the outcome of the research. Another benefit of the mixed method is that it strengthens the study findings through the process of triangulation (Timans, et al., 2019).

This study employed the mixed method. A semi-structured interview was used for the qualitative study as an approach to explore an area of research that is yet to be uncovered in Umgababa. Quantitative data was collected using and online questionnaire, which was analysed to determine how the collected data related to the study objectives. The rationale for choosing a combination of the quantitative and qualitative research methods was to investigate the perception of water conservation among the farming community of Umgababa, which will invariably provide robust and richer information, as compared to using a single method.

3.5 RESEARCH PHILOSOPHY

According to Zukauskas, Vveinhardt and Andriukaitiene (2018), a research philosophy deals with a worldview concerning how people arrive at what they call the “truth”, and every scholar is directed by their individual approach to their research. The research philosophy can be defined as the growth of research

assumption, its knowledge, and nature. Therefore, this implies that each researcher will likely have his/her own assumptions regarding the nature of truth and knowledge, as well as the attainment (Zukauskas, et al., 2018). The four key trends of research philosophy that are discussed by several research authorities are the positivist, interpretivist, pragmatist, and realistic research philosophies (Zukauskas, et al., 2018).

The positivist research philosophy believes that the social world can be comprehended in an objective way. For instance, the scientist is an objective analyst whose objectivity drives him/her to be secluded and work independently (Shorten & Smith, 2017). On the contrary, the interpretivist states that on the basis of the principles, it is difficult for the researcher to understand the social world (Saunders, et al., 2012). Hence, the interpretivist is the opposite of the positivist research philosophy. As the positivist believes that the social world can be viewed in an objective way, the interpretivist views social issues from a subjective manner (Hu, 2014). Hence, the interpretivist philosophy is based on the interest of the researcher in the study.

The pragmatist research philosophy focuses on evidence and facts. The view of this philosophy is mostly guided by the research problem, which deems practical results to be of utmost importance (Zukauskas, et al., 2018). Based on this type of research philosophy, the researcher has the liberty of choice to decide on the methods, techniques, and procedures that fit their research needs and study objectives (Zukauskas, et al., 2018). In conclusion, the realistic research philosophy depends on the principles of positivism and interpretivism. Hence, it is based on assumptions that are essential for the perception of the subjective nature of the human.

This study follows the pragmatist research philosophy, as pragmatism underpins the mixed research method (Almpanis, 2016) because pragmatism provides the researcher with the choice to decide on the methods, techniques and procedures that befit the research. Additionally, pragmatism is fits well with the mixed method

as it focuses its attention on a specific situation and utilises pluralistic approaches to extract knowledge about that situation (Almpanis, 2016).

3.6 STUDY LOCATION

The study was conducted at Umgababa as shown in the Figure 3-1 below.

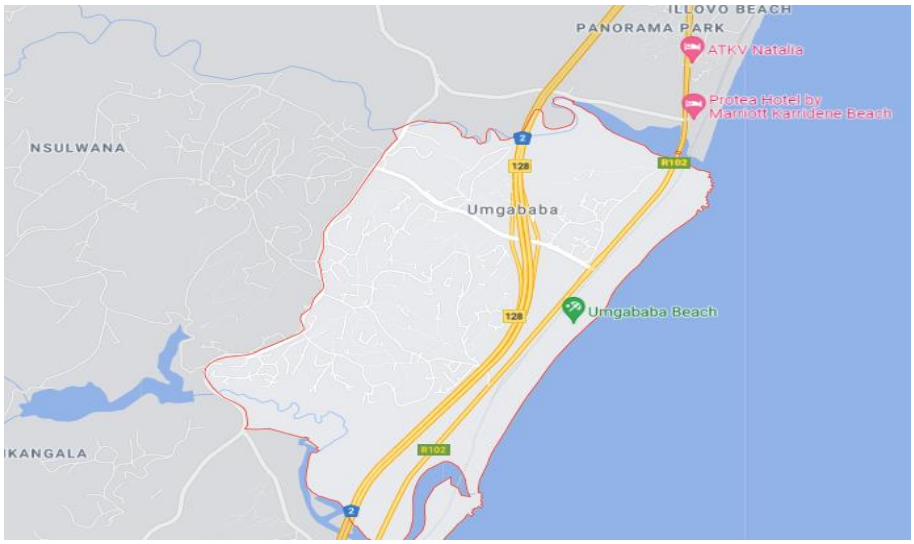

Figure 3-1: Map of Umgababa

Figure 3-1 above is a map of Umgababa, a rural settlement of over 5000 residents that is located approximately 40 kilometres south of the city of Durban in KwaZulu-Natal. The latitude is 30.1333º S, 30.8237 º E and about 51 metres above sea level. The Umgababa area is both rural and urban in nature, and is dominated by subsistence agriculture (Udidi Project Development, 2009). A sizeable portion of this community is made up of subsistence farmers, who are faced with the economic challenges of meeting individual and family needs. In the inland section, a number of sharp river valleys flowing west to east serve as substantial physical barriers. While some of the region is privately owned, the rest is held in traditional communal tenure. Densities vary significantly between informal urban and rural areas, with the former being significantly denser (Udidi Project Development, 2009). Located near

key transportation links, Umgababa has experienced modest economic development, and, with the exception of formal developments, restricted access to physical and social support services (Udidi Project Development, 2009).The plight of this rural community does not differ much from those in other rural areas of SA in terms of poverty and the need for development. This location fits the case study for this research because of the level of subsistence farming in place and the need for water conservation in the area.

3.7 POPULATION AND SAMPLE SELECTION

3.7.1 Study Population

The study population is seen as the participants of the study that make up the total population. Hu (2014) defines the study population as the subset of the target population from where the sample is selected. It is also seen as a collection of similar items which are important for a specific test or review. Kenton (2018) indicates that these samples usually relate to people or events. For the quantitative research method, the total population was made up of all smallholder farmers in Umgababa. For the qualitative study, the participants were specifically selected to participate in a semi-structured interview. The reason for selecting five (5) participants was the potential for a delay in response time for the semi-structured interview. The participants selected for the semi-structured interview came from the department of water and sanitation in the province of KwaZulu-Natal.

3.7.2 Sample and Size

The sub-category of a population is normally known as the sample size. The purpose of sampling is a means of indicating the exact number of elements from the given population (Sekaran & Bougie, 2013). An important aspect of sample size is that it ensures that the ideal estimations of the qualities of the selected sample are

applied to the population (Surbhi, 2016). According to Palinkas, Horwitz, Green, Wisdom, Duan and Hoagwood (2015), the two kinds of sampling that are typically used in research are classified probability and non-probability sampling. The nature of the probability sampling is such that all the elements of the population have a fair opportunity of being selected, while the same privilege is not offered under non-probability sampling (Sekaran & Bougie, 2013). Although the mixed method research was used for this study, the research followed a non-probability sampling.

To be more specific, the researcher used purposive (also known as judgemental) sampling for this research. The reason for using purposive sampling is it depends on the judgement of the researcher with a specific purpose in mind (Palinkas, et al., 2015). In this case, the researcher's focus was the smallholder farmers in Umgababa who had some degree of knowledge regarding water conservation and were willing to participate in the study, hence the selection was specifically tailored to them. In addition, judgemental sampling has the benefit of being time efficient and cost effective to use (Creswell & Creswell, 2018).). For the quantitative data collection, out of the entire population of smallholder farmers who were given the opportunity to participate in the study, a total of 61 participants were presented and completed the questionnaires while a total of five participants were selected for the semi-structured interview under qualitative data collection. The five respondents above were contacted by the researcher and intimated on the requirements of the study. These respondents willingly accepted to be part of the study and their years of experience in the industry made them good candidates for the interview.

3.8 RESEARCH INSTRUMENT

A research instrument is a tool used in collecting, measuring and analysing data relevant to a research topic (Birmingham & Wilkinson, 2003). Some common research instruments are inclusive of interviews, focus group discussions,

questionnaires and observations (Yin, 2018). This study predominantly used two research instruments, namely, an interview schedule and questionnaire.

As highlighted by Doyle (2020), the interview schedule followed the semi-structured pattern, which strictly contained formalised items of questions but motivated the interviewer to ask more open-ended questions. The reason for this is that it creates an opportunity for a question instead of a straightforward question and the corresponding answer format (Doyle, 2020). This type of interview approach is also used when the researcher is not guaranteed to get more than one chance to interview the respondent. Semi-structured interviews are generally recommended for mixed method research, as it helps during the qualitative phase of the study to explore new concepts that help in the generation of hypothesis or explain results from a quantitative phase that tests hypothesis (DeJonckheere & Vaughn, 2018). The nature of a semi-structured interview is not only open-ended; but also neutral, clear and free of leading statements or wordings (DeJonckheere & Vaughn, 2018).

Some of the benefits of close ended questions include the fact that they have a loose and flexible arrangement, can be scheduled ahead of time, helps to explore the thought of the participant and still is usually the most predominant way for data collection for a qualitative study (DeJonckheere & Vaughn, 2018). It is important to also highlight that there are several demerits to the semi-structured interview. For instance, it is likely that the interviewer may forget valuable questions if they become engrossed in the conversation (Doyle, 2020). In addition, semi-structured interviews have the potential of having bias as all the candidates are asked the same set of questions. The interview schedule contained ten (10) questions that addressed specific aspects that the researcher intended to cover.

Questionnaires on the other hand is a multistage process that requires attention to many details at once. A questionnaire is a research instrument consisting of a series of questions for the purpose of gathering information from the respondents (Creswell & Creswell, 2018). Designing the questionnaire is complicated because surveys can ask about topics in varying degrees of detail. Questions can be asked in different

ways, and questions asked earlier in a survey may influence how people respond to later questions. The questionnaire used in this study was designed by the researcher and pilot tested to enhance the level of internal validity. The questions were drafted in English, while also translating each of these questions into IsiZulu to accommodate participants who were more fluent in IsiZulu. The format of the questionnaire followed a Likert scale line of questioning to gain insight into the farmers' perception of water conservation. The questionnaire was categorised into four sections (A, B, C and D) as follows:

Section A: Demographics of participants

Section B: Perception of water conservation

Section C: Water conservation techniques

Section D: Challenges

3.9 PILOT STUDY

It is always vital to perform a pilot study beforehand as it assists the researcher to design and implement a large-scale project more systematically and efficiently (Crossman, 2019). A pilot test was conducted to determine if the questions were clear and understandable. Pilot testing utilises the experience scholars to rate questions according to the quality and complexity of the answers received. This enables each of the participants to consider the problem identification equally and outline empirical data for the analysis. At the start of the current study, a quantitative pilot test was carried out on five community members of the Umgababa farming community, while two interviews were conducted with two distinct respondents. After the pilot study, the researcher was able to outline unnecessary and inappropriate questions, which were later modified. The pilot study also enabled the researcher to ascertain the time taken to complete the questionnaire and the semi-structured interview.

3.10 ADMINISTRATION OF QUESTIONNAIRES AND INTERVIEW SCHEDULE

This sub-section outlines a short description of how the researcher intended to collect information (data) from the study participants.

3.10.1 Questionnaire Administration

In soliciting information from farmers through a questionnaire, permission was obtained from the community heads in Umgababa. The researcher also obtained also the letter of consent and Gate keeper's letter from the Durban University of Technology. Prior to the collection of data, the researcher explained to the respondents the purpose of the study, thereby notifying them that their participation was voluntary and that they may withdraw from participating without giving any reasons or explanation at any time during the interview.

Thereafter, the researcher visited Umgababa with the support of a research assistant for the distribution and collection. The researcher also collected the questionnaires immediately after they were completed. It is believed that the presence of the researcher on the field motivated the participants to complete the questionnaires, thereby increasing the response rate. In addition, the researcher provided clarity on the questions that arose while the participants completed the questionnaires without influencing their responses.

3.10.2 Interview Process

Like the questionnaire administration process, the researcher introduced the research after providing the letter of consent and the gate keeper's letter to research participants. Due to the restrictions imposed by a number of governmental departments such as the Department of Water and Sanitation (in abiding with the

COVID-19 regulations), the researcher conducted the interviews telephonically. To prepare the participants, the interview questions for the qualitative data collection were sent in advance via email to the respondents and an agreed date and time was set based on their availability. Thereafter, interviewees were contacted telephonically. The outcome of the interviews was recorded for review and transcribed afterwards.

3.10.3 Storage and Data Security

By abiding by the research ethics stipulated by the Durban University of Technology on data storage and disposal, the researcher ensured that the completed questionnaires were kept in the supervisor's office. More so, only the supervisor, research assistant, statistician, and researcher had access to these questionnaires. Ten years after completion of the research, the questionnaires will be destroyed. The telephonic recordings with interviewees will be downloaded on researcher's laptop, which is secured with a password. Ten years after the completion of the study, these recordings will then be deleted.

3.11 DATA ANALYSIS

The assessment of data by the researcher is usually considered one of the most difficult because of the time it takes (Erlingsson & Brysiewicz, 2017). Some researchers had previously expressed that the protocols and work involved in data analysis can be irritating and tough (Erlingsson & Brysiewicz, 2017). However, data analysis is a core aspect of any research work. According to Vosloo, Fouche and Barnard (2014), data analysis is a means of organising, classifying and arranging a large volume of data into meaningful information. The responses gathered from the questionnaires were analysed using the Statistical Package for the Social Sciences (SPSS) version 24.0. The data collected was analysed using descriptive statistics involving the use of frequencies, percentages. The inferential statistics was also

used in determining regression. The quantitative data was analysed from an inferential and descriptive statistical point of view. This was further analysed with the aid of histograms, bar charts, pie charts and tables.

This study utilised the thematic analysis approach for the assessment of the semi-structured questionnaires. This method uses the means of recognising, analysing and presenting patterns, usually known as themes (Dudovskiy, 2018). The key questions were presented in form of themes and sub-themes.

3.12 RELIABILITY AND VALIDITY

Reliability is the extent to which the same finding will be obtained if the study was repeated at another time by another researcher (Sekaran & Bougie, 2013). If the same finding can be obtained again, the instrument is consistent or reliable. Conversely, validity is seen as the degree that the research instrument measures what it claims to measure (Cooper & Schindler, 2011). Validity depends on survey design, identification of its purpose, applicable definitions, questions, and structure of its purpose, which happens primarily before the data collection phase.

To ensure validity and reliability in this study, the following procedures were adhered to:

- Questions asked were associated with the research aim and objectives
- Questions were drafted in simple words
- Questions were in English and IsiZulu, which are the predominant languages spoken in Umgababa
- The research instruments were pilot tested
- The researcher ensured that the respondents shared their views without any intimidation

3.13 LIMITATIONS OF THE STUDY

The potential limitations of the study were time constraints and the likelihood of respondents supplying invalid information. Therefore, the aggregate of all the participants' views will be evaluated, to get a general perception of the community's view about interest. The study was confined to only the Umnini area of Umgababa which is situated on the south eastern axis of the KwaZulu-Natal Province. Hence, the findings cannot be generalised to other rural communities in SA. More so, the study primarily focuses on the perceptions of water conservation among farmers in this community.

3.14 ETHICAL CONSIDERATION

The role of ethics in a research study is to safeguard the participants, thereby making sure that they are not affected negatively because of the research activities (Cooper & Schindler, 2011). As highlighted by Saunders, Lewis and Thornhill (2015), not applying ethical considerations could lead to exposing respondents' secrecy which can lead to misrepresentation. As a result, such a study can be deemed to mislead participants thereby disregarding legal concerns (Saunders et al., 2015).

The current study adhered to the ethical standards stipulated by the Durban University of Technology. Ethical concerns which deal with the participants' confidentiality were observed. Furthermore, the researcher also ensured that sources used were 'appropriately referenced'. Many issues on ethics in research normally fall into five categories namely: informed consent, harm protection, right to privacy, honesty with participants and the internal review board (Saunders et al., 2015). This study gave much relevance to these ethical considerations.

As previously mentioned, each of the research participants was given a consent letter. This enabled the participants to have a better understanding of the study, while each one of them was also made to sign the document. The researcher also

ensured that the participants were not exposed to any harm as a result of the study, be it psychological or physical harm. Other particulars such as the names were changed for codes in order to ensure anonymity. The essence of confidentiality and anonymity is to always protect respondents' information and respect their worth and dignity independent of their health, psychological or social status.

3.15 CONCLUSION

A description of the research method pursued in this study was outlined in this chapter. Thus, the procedure followed prior to the data collection, till the actual data collection was explicitly explained herein. Additionally, the researcher detailed the research design, target population, sampling method, data collection process, data analysis amongst other relevant themes. The next chapter presents the interpretation of the data and results.

CHAPTER 4
PRESENTATION OF RESULTS

4.1 INTRODUCTION

The previous chapter outlined the relevant research methodology that was applied to this study. This chapter presents the results obtained from the questionnaires and the analysis. The data was analysed from a descriptive and the inferential statistic point of view. The outcomes from data analysis were presented using histograms, pie charts, bar charts and tables.

SECTION A: QUANTITATIVE DATA ASSESSMENT

4.2 DEMOGRAPHIC INFORMATION

The demographic characteristics of the respondents are detailed in this section.

4.2.1 Gender

The respondents' gender is shown in Table 4-1 below. More respondents were females (54%) while males constituted 46%.

Table 4-1: Gender of respondents

		Frequency	Percent
Gender	Male	28	45.9
	Female	33	54.1
	Total	61	100.0

4.2.2 Age Group

The Figure 4-1 below presents the age group of the respondents.

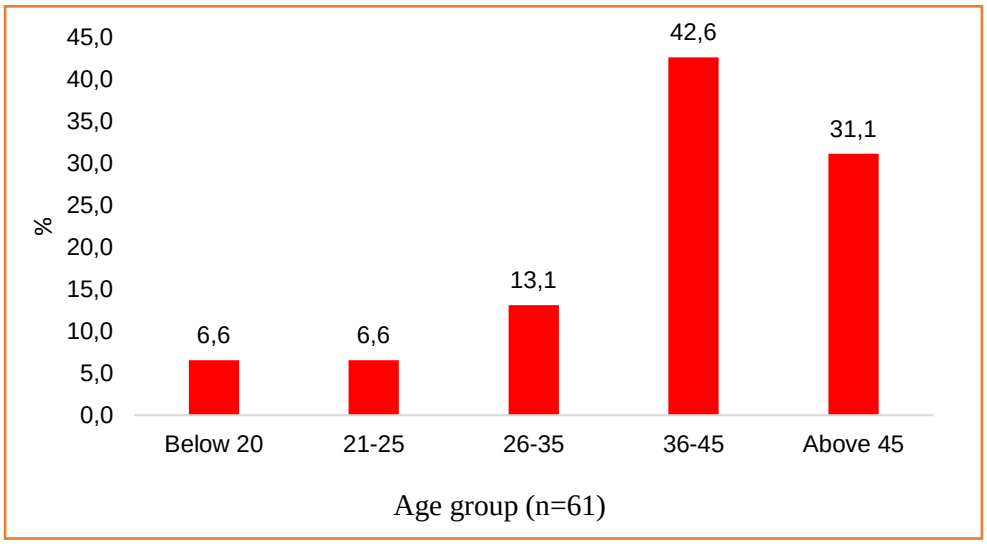

Figure 4-1: Respondents age group distribution

Figure 4-1 above shows that 42.6% of the respondents were within 36-45 years of age, 31.1% above 45 years, 13.1% were within 26-35 years of age, while 21-25 years and below 20 years each form 6.6% of the respondents. The fact that most of the participants, roughly 73%, were above 35 years indicates that the respondents are mature. This further implies that more mature respondents participated in the study.

4.2.3 Race

The Figure 4-2 below depicts the racial group of the respondents.

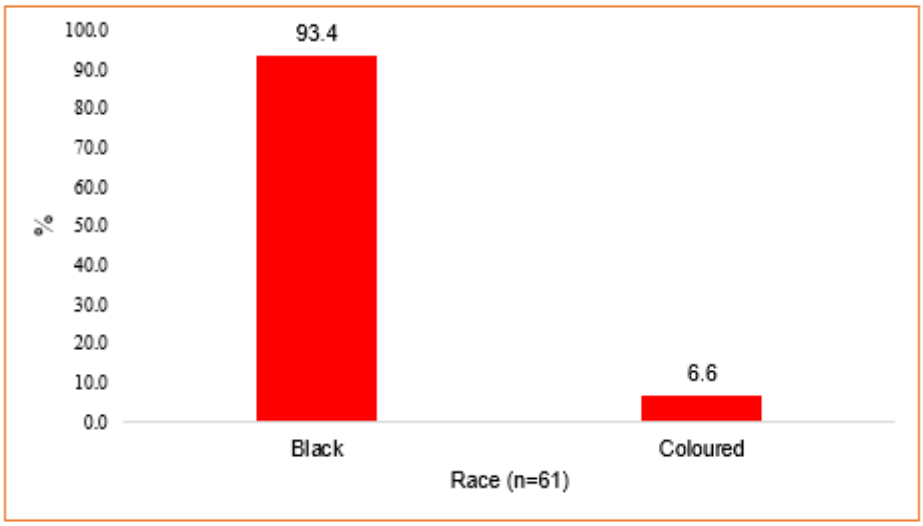

Figure 4-2: Respondents Race

From the Figure 4-2 above, most of the respondents (93.4%) identified as black while only 6.6% identified as coloured.

4.2.4 Type of dwelling

The Figure 4-3 below presents the nature of participants' dwelling.

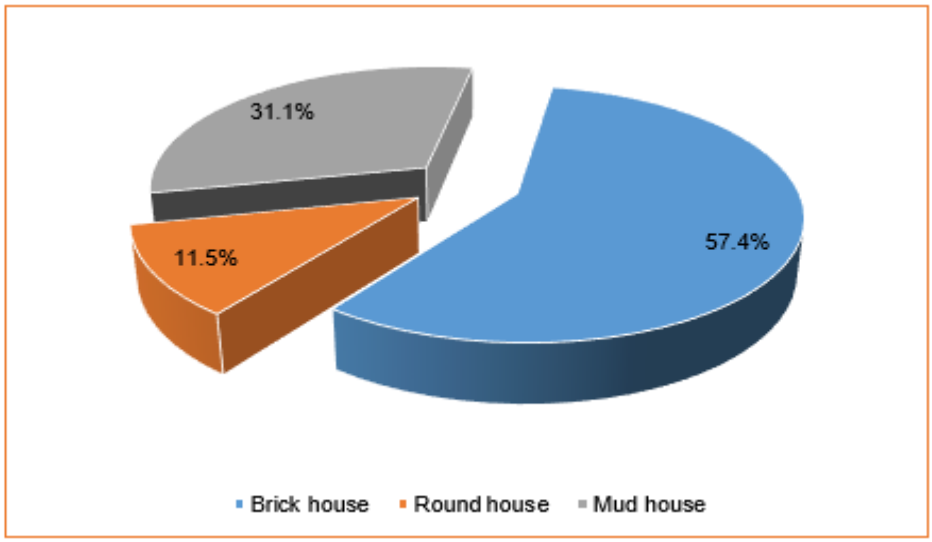

Figure 4-3: Type of dwelling

The Figure 4-3 above reveals that more than half of the respondents (57.4%) dwelt in brick houses, 31.1% in mud houses, and 11.5% in roundhouses.

4.2.5 Occupation

Table 4-2 below shows the respondents' occupation.

Table 4-2: Respondents Occupation

		Frequency	Percent
Occupation	Farming	13	21.3
	Non-farming	10	16.4
	Informal trading	7	11.5
	Unemployed	31	50.8
	Total	61	100.0

From the Table 4-2 above, half of the respondents 50.5% were unemployed, 21.3% were farmers, 16.4% were non-farmers, and 11.5% were involved in informal trading.

4.2.6 Highest Level of Education

Figure 4-4 below shows the highest qualification of the participants.

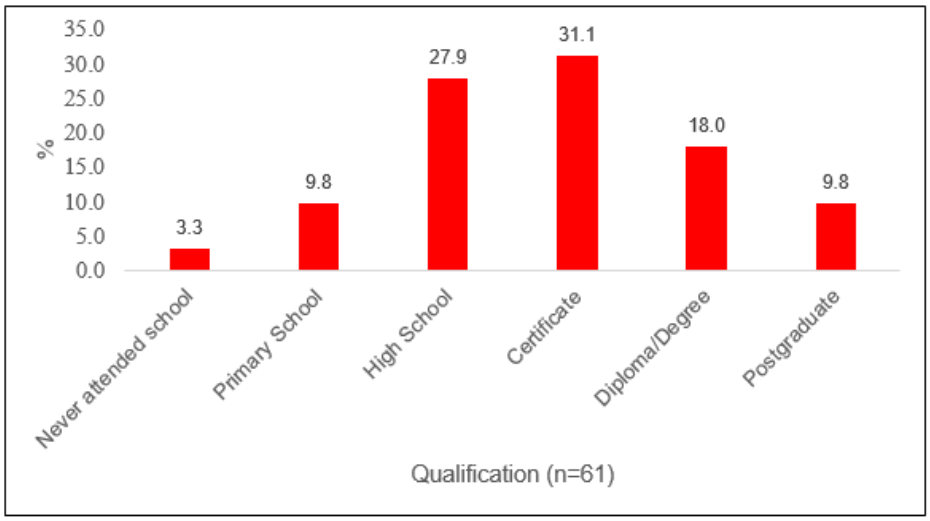

Figure 4-4: Highest qualification

Figure 4-4 above shows that 31.1% of the respondents hold certificate level qualification, 27.9% holds high school level qualification, 18% holds diploma/degree level qualification, 9.8% holds primary school level qualification, 9.8% holds postgraduate level qualification while 3.3% of the respondents have never attended school. The fact that majority of the respondents only had certificate or less shows most of the farmers only have basic education.

4.2.7 Type of housing ownership

Figure 4-5 below shows the respondents type of housing ownership. It was found that 32.8% owned their property while 31.1% were renting.

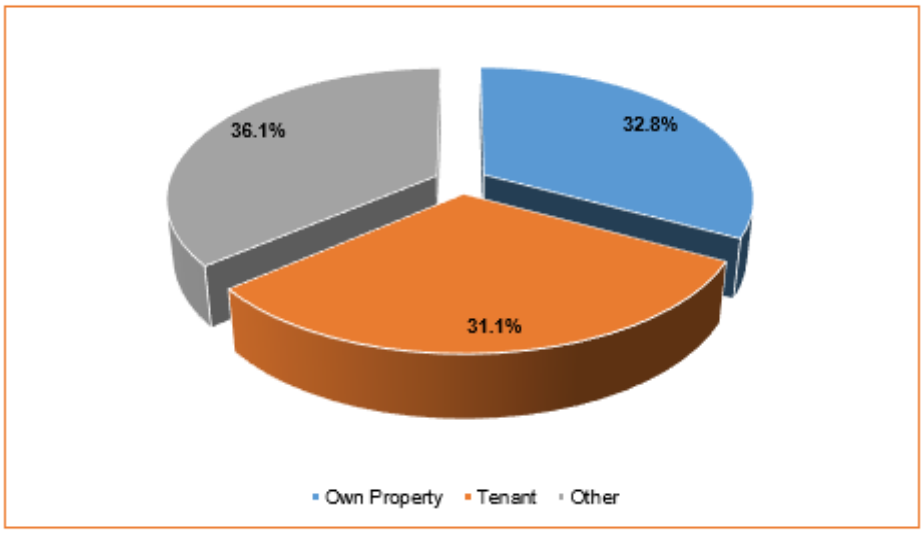

Figure 4-5: Type of house ownership

4.2.8 People Living in Household

Table 4-3 below shows the people living in the household.

Table 4-3: Number of people living in respondent's household

		Frequency	Percent
Number of people	Less than 3	12	19.7
	4-6 people	24	39.3
	6-8 people	16	26.2
	More than 8	9	14.8
	Total	61	100.0

From the Table 4-3 above, 39.3% of the respondents had 4 to 6 people living in their households, 26.2% had 6 to 8 people living in their households, 19.7% had less than 3 people while 14.8% had more than 8 people living in their households.

4.2.9 Average Monthly Income of Households

As shown in Table 4-4 below, 41% of the respondents' households earn R3 000 and more on average monthly, 37.7% earn between R2 000-R3 000 while 21.3% indicated that their household average income per month is less than R1 000.

Table 4-4: Average monthly income of respondents' households

		Frequency	Percent
Average income	Less than R1 000	13	21.3
	R2 000-R3 000	23	37.7
	R3 000 and more	25	41.0
	Total	61	100.0

4.2.10 Household Main Source of Income

Table 4-5 below shows the respondents' households main source of income.

Table 4-5: Respondents household main source of income

		Frequency	Percent
Main source of income	Livestock	13	21.3
	Crop production	17	27.9
	Informal trading	4	6.6
	Tourism	3	4.9
	Social grants	20	32.8
	Other	4	6.6
	Total	61	100.0

As shown in Table 4-5 above, 32.8% of the respondent's household's main source of income was from the social grants, while 27.9% of the household's main source of income was crop production, 21.3% indicated that the main source of income was livestock, 6.6% indicated informal trading as the main source of income, 4.9% indicated tourism as main source of income while 6.6% indicated other sources as main source of income. Overall, it can be drawn from the table that 49.2% of the respondent's main source of income came from farming activities in contrast to 50.9% that came from non-farming activities.

4.2.11 Water Source for Farming

Table 4-6 below shows the water source for farmers in the Umgababa area.

Table 4-6: Water source for farming

		Frequency	Percent
Water source	Rain water	16	26.2
	River/stream	16	26.2
	Irrigation	21	34.4
	Bore hole	8	13.1
	Total	61	100.0

As shown in Table 4-6, 34.4% of the respondent's use irrigation for farming, 26.2% each use rainwater and river/stream, and 13.1% use borehole water for farming.

4.2.12 Source of Household Water Supply

Figure 4-6 below shows the source of household water supply.

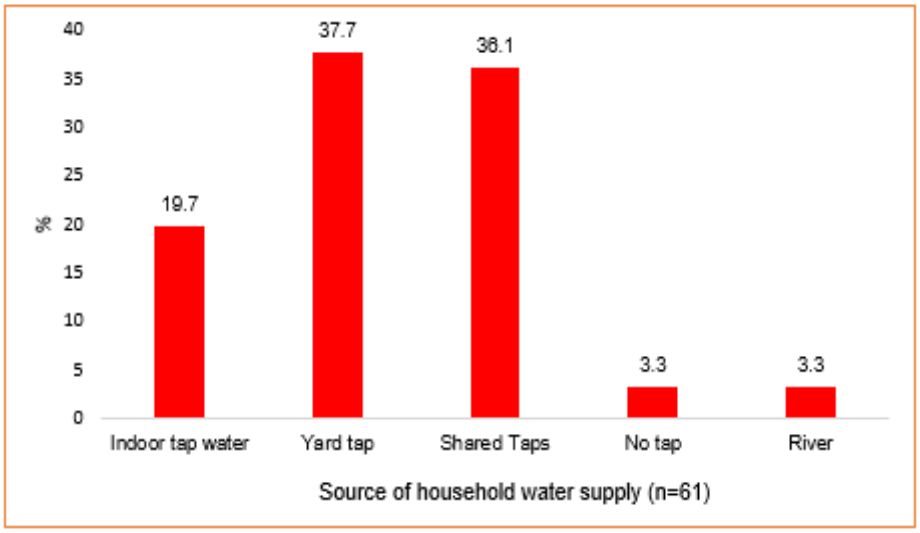

Figure 4-6: Respondents' source of household water supply

From the Figure 4-6 above, it was observed that 37.7% of the respondent's household water supply comes from a yard tap, 36.1% from shared taps, 19.7% from indoor tap water, while 3.3% each indicated their water supply comes from the river and no tap, respectively.

4.3 PERCEPTION OF WATER CONSERVATION

Table 4-7 below presented the respondents' perceptions of water conservation.

Table 4-7: Respondents' perception of water conservation

	Perception of water conservation (n=61)							*P*-value
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean	SD	
Farmers are required to have a positive perception of water conservative techniques	41%	50.8%	8.2%	0%	0%	1.67	0.625	0.00***
The Department of Water and Sanitation provides awareness campaigns on water conservation techniques in farming	23%	50.8%	3.3%	19.7%	3.3%	2.30	1.131	0.00***

	Perception of water conservation (n=61)							*P*-value
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean	SD	
The Umgababa farming community has a good water conservation culture	9.8%	31.1%	24.6%	27.9%	6.6%	2.90	1.121	0.00***

As shown in Table 4-7 above, there is a significant agreement that farmers are required to have a positive perception of water conservation techniques, with yielded results given as ($M=1.67 \pm 0.625$; $p<0.001$). Equally, there is significant agreement that the Department of Water and Sanitation provided awareness campaigns on water conservation techniques in farming, with results indicated as ($M=2.30 \pm 1.131$, $p<0.001$). However, the mean value measured for the statement “the Umgababa farming community has a good water conservation culture” were closest to indifferent ($M=2.90 \pm 1.121$). This suggests that the respondents neither agreed nor disagreed with the statement. Overall, the statements that had the strongest response from the respondents revealed that farmers are required to have a positive perception of water conservation techniques. In other words, they must maintain a positive awareness of the techniques of water preservation.

4.3.1 Association between Demographic and Perception of water Conservation

One-way analysis of variance was performed to determine whether respondents differ in their perception of water conservation. The results are summarised in Table 4-8 below.

Table 4-8: Relationship between demographic variables and perception of water conservation

Socio-demographic characteristics		N (61)	Mean	Std. Deviation	P value
Gender	Male	28	2.48	.57684	0.038**
	Female	33	2.13	.67669	
Age group	Below 20	4	2.00	.00000	0.047**
	21-25	4	2.50	.19245	
	26-35	8	2.21	.81528	
	36-45	26	2.08	.78490	
	Above 45	19	2.63	.26977	
Race	Black	57	2.30	.65974	0.699*
	Coloured	4	2.17	.57735	
Type of dwelling	Brick house	35	2.16	.70187	0.043**
	Round house	7	2.10	.78680	
	Mud house	19	2.60	.36139	
Occupation	Farming	13	2.26	.43363	0.438*
	Non-farming	10	2.60	.64406	
	Informal trading	7	2.19	.87891	
	Unemployed	31	2.23	.67433	
	Never attended school	2	2.67	.00000	0.005**
	Primary School	6	1.89	.45542	
	High School	17	2.55	.38982	
	Certificate	19	2.51	.64184	

Socio-demographic characteristics		N (61)	Mean	Std. Deviation	P value
Highest level of education	Diploma/Degree	11	2.00	.51640	
	Postgraduate	6	1.67	1.03280	
Type of housing ownership	Own Property	20	2.57	.43394	0.045**
	Tenant	19	2.25	.71009	
	Other	22	2.08	.69717	
People living in household	Less than 3	12	1.67	.63564	0.000**
	4-6 people	24	2.11	.47819	
	6-8 people	16	2.73	.53359	
	More than 8	9	2.81	.24216	
Household average monthly income	Less than R1 000	13	2.36	.49929	0.157*
	R2 000-R3 000	23	2.09	.74683	
	R3 000 and more	25	2.44	.59876	
Household main source of income	Livestock	13	2.41	.45448	0.930*
	Crop production	17	2.29	.93454	
	Informal trading	4	2.17	.96225	
	Tourism	3	2.22	.96225	
	Social grants	20	2.30	.44459	
	Other	4	2.00	.00000	
Water source for farming	Rain water	16	2.23	.96393	0.353*
	River/stream	16	2.54	.34157	
	Irrigation	21	2.19	.52251	
	Bore hole	8	2.17	.64242	
Source of household water supply	Indoor tap water	12	2.00	.98473	0.400*
	Yard tap	23	2.33	.50252	
	Shared Taps	22	2.39	.59661	

Socio-demographic characteristics		N (61)	Mean	Std. Deviation	P value
	No tap	2	2.00	.00000	
	River	2	2.67	.00000	
P* >5% P** <5%					

From Table 4-8 above, the ANOVA value indicated that there was no statistically significant difference in the respondents' race, occupation, household's average monthly income, household's main source of income, water source for farming, source of household water supply, and their perception of water conservation (P > 0.05). This suggests that regardless of the demographic variables, their perception of water conservation is the same.

On the other hand, the ANOVA value indicates that there is a significant difference in terms of the respondents' gender and the perception of water conservation (P=0.038). It was found that female respondents (M=2.13 ± 0.677) agreed more with the statements on the perception of water conservation when compared to the male (M=2.48 ± 0.677).

The ANOVA value measured for the age group indicates that there was a statistically significant difference (P=0.047). The mean value measured for the respondents below 20 years of age was the lowest (M=2.00 ± 0.000), while the respondents above 45 years had the highest mean value (M=2.63 ± 0.660). This suggests that respondents below 20 years agreed more with the statement measuring perception of water conservation.

In terms of the type of dwelling, the ANOVA test indicates that there is a significant difference in the perception of water conservation (P=0.043). The mean value measured for the respondents living in round houses (M=2.10 ± 0.787) was the lowest, while those found for those living in mud houses was the highest (M=2.60 ±

0.361). This suggests that more respondents living in the round houses agreed with the perception of water conservation when compared to those living in mud houses. In other words, respondents from different types of dwellings responded differently to the statement.

In terms of the respondents' highest qualification, the ANOVA value indicated there is a significant difference in their perception of water conservation (P=0.005). The mean value measured for respondents with postgraduate qualifications was the lowest (M=1.67 ± 1.032), while those found for respondents that never attended school was the highest (M=2.67 ± 0.000). This suggests that more respondents with postgraduate qualifications agreed with the statements measuring the perception of water conservation.

Regarding the type of housing ownership, the ANOVA test indicated that there is a significant difference in the perception of water conservation (P=0.045). The mean value measured for respondents that indicated other type of house ownership was the lowest (M=2.08 ± 0.697), while the mean value measured for respondents who own the property was the highest (M=2.57 ± 0.434). This suggests that respondents with other type of housing ownership agreed more with the statements measuring perception of water conservation.

In terms of people living in the household, the ANOVA value indicated that there is a statistical difference in their perception of water conservation ($p<0.001$). The mean value measured for less than 3 people was the lowest (M=1.67 ± 0.636) while the mean value measured for more than 8 people was the highest (M=2.81 ± 0.242). This suggests that respondents having less than 3 people living in their household agreed more with the statements measuring perception of water conservation.

4.4 WATER CONSERVATION TECHNIQUES

This section addressed water conservation techniques. Here the techniques most familiar by the respondents and their knowledge of water conservation techniques are presented below.

4.4.1 Familiarisation of Water Conservation Techniques

Figure 4-6 below presents the familiarisation of water conservation techniques.

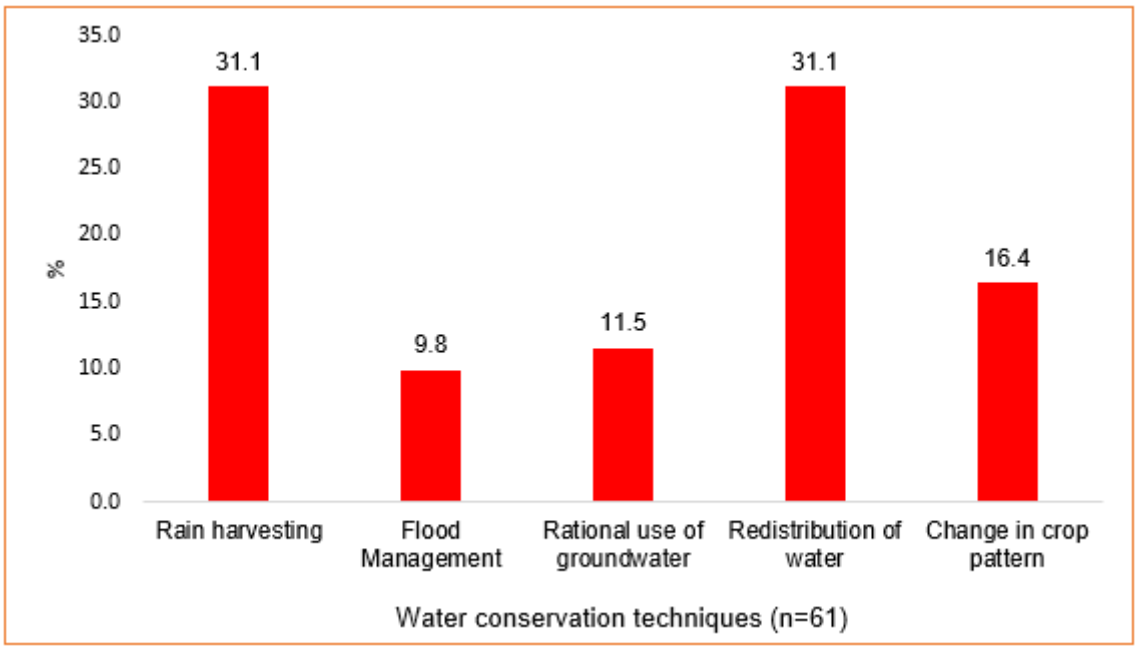

Figure 4-7: Familiarisation of water conservation techniques

From Figure 4-7 above, equal percentage (31.1%) are familiar with rain harvesting and redistribution of water, 16.4% are familiar with change in crop pattern, 11.5% are familiar with rational use of water, and 9.8% are familiar with flood management as water conservation techniques.

4.4.2 Knowledge of Water Conservation Techniques

This section sought to know the respondents' knowledge of water conservation techniques and is presented in Table 4-9 below.

Table 4-9: Respondents' knowledge of water conservation techniques

	Knowledge of water conservation techniques (n=61)							*P*-value
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean	SD	
I have adequate knowledge on Water conservation techniques?	13.1%	67.2%	8.2%	9.8%	1.6%	2.20	0.853	0.00***
The farming community of Umgababa have a good understanding of water conservation techniques?	0%	49.2%	13.1%	31.1%	6.6%	2.95	1.040	0.00***
Water conservation techniques are widely adopted by farmers in Umgababa?	6.6%	41%	23%	23%	6.6%	2.82	1.073	0.00***

From Table 4-9 above, there is a significant agreement which shows that farmers had adequate knowledge on water conservation techniques, with yielded results given as ($M=2.20 \pm 0.853$; $p<0.001$). In terms of the statement "the farming

community of Umgababa have a good understanding of water conservation techniques", nearly half (49.2%) agreed with the statement. Nevertheless, the mean value measured for the statement was closest to "indifferent". This suggests that more of the respondents neither agreed nor disagreed that the farming community of Umgababa had a good understanding of water conservation techniques, with results yielding as ($M=2.95 \pm 1.040$; $p<0.001$).

Regarding the statement "water conservation techniques are widely adopted by farmers in Umgababa", 41% agreed with the statement. However, the mean value measured was closest to 'indifferent', which suggests that more of the respondents neither agreed nor disagreed, with results given as ($M=2.82 \pm 1.073$; $p<0.001$). Overall, the first statement that had the respondents most support which suggests that respondents had adequate knowledge of water conservation techniques.

4.4.3 Association between Demographic and Knowledge of Water Conservation Techniques

One-way ANOVA was performed to determine whether respondents differed in their knowledge of water conservation techniques. Hence, the relationship between demographic variables and knowledge of water conservation techniques is presented in Table 4-10 below.

Table 4-10: Relationship between demographic variables and knowledge of water conservation techniques

Socio-demographic characteristics		N (61)	Mean	Std. Deviation	P value
Gender	Male	28	2.62	.65868	0.691*
	Female	33	2.69	.66112	

Socio-demographic characteristics		N (61)	Mean	Std. Deviation	P value
Age group	Below 20	4	2.00	.00000	0.073*
	21-25	4	2.50	.57735	
	26-35	8	3.13	.73328	
	36-45	26	2.65	.73322	
	Above 45	19	2.63	.47002	
Race	Black	57	2.68	.66656	0.313*
	Coloured	4	2.33	.38490	
Type of dwelling	Brick house	35	2.52	.62249	0.063*
	Round house	7	3.14	.63413	
	Mud house	19	2.72	.65981	
Occupation	Farming	13	2.36	.37172	0.079*
	Non-farming	10	3.07	.51640	
	Informal trading	7	2.71	.95119	
	Unemployed	31	2.63	.66864	
Highest level of education	Never attended school	2	3.33	.00000	0.000**
	Primary School	6	3.67	.51640	
	High School	17	2.43	.48254	

Socio-demographic characteristics		N (61)	Mean	Std. Deviation	P value
	Certificate	19	2.67	.62854	
	Diploma/Degree	11	2.55	.50050	
	Postgraduate	6	2.22	.62063	
Type of housing ownership	Own Property	20	2.83	.67970	
	Tenant	19	2.88	.69576	0.005**
	Other	22	2.30	.43533	
People living in household	Less than 3	12	2.78	.99832	
	4-6 people	24	2.47	.57245	0.375*
	6-8 people	16	2.75	.49441	
	More than 8	9	2.81	.52997	
Household average monthly income	Less than R1 000	13	2.7692	.67199	
	R2 000-R3 000	23	2.65	.78160	0.758*
	R3 000 and more	25	2.60	.52705	
Household main source of income	Livestock	13	2.41	.33758	0.046**
	Crop production	17	2.71	.61104	

Socio-demographic characteristics		N (61)	Mean	Std. Deviation	P value
	Informal trading	4	3.33	.76980	
	Tourism	3	2.89	.96225	
	Social grants	20	2.73	.73030	
	Other	4	2.00	.00000	
Water source for farming	Rain water	16	2.56	.76709	
	River/ stream	16	2.67	.66667	0.107*
	Irrigation	21	2.52	.48957	
	Bore hole	8	3.17	.64242	
Source of household water supply	Indoor tap water	12	2.50	.68902	
	Yard tap	23	2.36	.53099	
	Shared Taps	22	2.86	.56023	0.000**
	No tap	2	4.00	.00000	
	River	2	3.33	.00000	
P* >5% P** <5%					

The ANOVA value revealed that there was no statistically significant difference in the respondents' gender, age group, race, occupation, household average monthly income, the water source for farming, type of dwelling, people living in the

household, and their knowledge of water conservation techniques (P>0.05). This suggests that regardless of the demographic variables, their knowledge of water conservation was the same.

On the hand other, the ANOVA value indicated that there is a significant difference in terms of the respondents' highest qualification and knowledge of water conservation techniques (p<0.001). The mean value measured for respondents with postgraduate qualification was the lowest (M=2.22 ± 0.621), while those found for respondents that had primary school was the highest (M=3.67 ± 0.516). This suggests that more respondents with postgraduate qualifications had more knowledge on water conservation techniques when compared to other groups, thus implying the importance of education and the role it plays in embracing water conservation. The lower proportion of participants without postgraduate qualification also showed that these participants were likely not informed on the developments and potential benefits of water conservation for rural farmers.

Regarding the type of housing ownership, the ANOVA test indicates that there are significant differences in the knowledge of water conservation techniques (P=0.005). The mean value measured for respondents that indicated other type of house ownership was the lowest (M=2.30 ± 0.435), while those measured for respondents that own the property was the highest (M=2.88 ± 0.696). This suggests that respondents with other type of housing ownership agreed more with the statements which sought to measure their knowledge of water conservation techniques.

In terms of household's main source of income, the ANOVA value measured indicates that there was a statistical difference in the knowledge of water conservation techniques (P=0.046). It was found that respondents with other source of income had the lowest mean value (M=2.00 ± 0.000), while those in informal trading had the highest mean value (M=3.33 ± 0.770). This suggests that respondents with other source of income had less knowledge of water conservation

techniques. It also shows that those with informal trading understand the role of water conservation techniques, as it probably affects their means of livelihood.

In terms of the source of household water supply, the ANOVA test indicated that there is a significant difference in their knowledge of water conservation techniques ($p<0.001$). The mean value measured for the respondents with yard tap ($M=2.36 \pm 0.531$) was lowest while those with no tap was the highest ($M=4.00 \pm 0.000$). This suggests that respondents with yard tap water supply had lesser knowledge on water conservation techniques. The fact that respondents with no tap agreed strongly with this statement, it also implies that water conservation approaches benefit them in one way or another.

4.5 ADAPTABILITY OF WATER CONSERVATION TECHNIQUES

This section sought to address the adaptability of water conservation techniques, ranking of water conservation techniques and the association between demographic and adaptability of water conservation techniques.

4.5.1 Respondents Views on the Statements Measuring Adaptability of Water Conservation Techniques

The feedback of the respondents' views on the statements measuring adaptability of water conservation techniques is presented in Table 4-11 below.

Table 4-11: Respondents views on the statement measuring adaptability of water conservation techniques

	Adaptability of water conservation techniques (n=61)							*P*-value
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean	SD	
The water conservation techniques used by Umgababa farmers are sustainable?	6.6%	24.6%	26.2%	39.3%	3.3%	3.08	1.021	0.00***
The farmers of Umgababa are beginning to adopt sophisticated water conservative techniques?	0%	37.7%	36.1%	23%	3.3%	2.92	0.862	0.00***
The farmers of Umgababa use traditional water conservative techniques?	24.6%	44.3%	14.8%	6.6%	9.8%	2.33	1.207	0.00***

As shown in Table 4-11 above, the mean value measured for the first statement, which referred to the ‘water conservation techniques used by Umgababa farmers are sustainable’ was closest to ‘neutral’. This suggests that more of the respondents neither agreed nor disagreed with the “water conservation techniques used by

Umgababa farmers are sustainable", with results yielding as (M=3.08 ± 1.021; p<0.001).

In terms of the statement "the farmers of Umgababa are beginning to adopt sophisticated water conservation techniques", the mean value measured for the statement was closest to "neutral". This suggests that more of the respondents neither agreed nor disagreed that the farmers of Umgababa were beginning to adopt sophisticated water conservation techniques, with results yielding as (M=2.92 ± 0.8462; p<0.001). However, there is a significant agreement that farmers of Umgababa use traditional water conservation techniques, with yielded results given as (M=2.33 ± 1.207; p<0.001).

Overall, the third statement had the respondents most support which suggests that farmers of Umgababa use traditional water conservation techniques.

4.5.2 Ranking of Water Conservation Techniques

Table 4-12 below presents the ranking of water conservation techniques.

Table 4-12: Respondents ranking of the adaptability of water conservation techniques

		Frequency	Percent	Mean	Std.Dev
Extent of adaptability	Extremely adaptable	12	19.7	2.87	1.297
	Always Adaptable	11	18.0		
	Adaptable	19	31.1		
	Occasionally adaptable	11	18.0		
	Not adaptable	8	13.1		
	Total	61	100.0		

As shown in Table 4-12, 31.1% of the respondents ranked the extent of adaptability of the water conservation techniques used in Umgababa as adaptable, 19.7% ranked it as extremely adaptable, 18% ranked it as occasionally adaptable while 13.1% ranked it not adaptable. The mean suggests that the extent of adaptability of water conservation techniques in Umgababa is adaptable (M=2.87 ± 1.297; p<0.001).

4.5.3 Association between Demographics and Adaptability of Water Conservation Techniques

Table 4-13 below presents the association between demographics and the adaptability of water conservation techniques.

Table 4-13: Relationship between demographic variables and adaptability of water conservation techniques

Socio-demographic characteristics		N (61)	Mean	Std. Deviation	P value
Gender	Male	28	2.80	.76087	0.810*
	Female	33	2.76	.52884	
Age group	Below 20	4	2.33	.38490	0.200*
	21-25	4	3.33	.00000	
	26-35	8	2.96	.45207	
	36-45	26	2.77	.81524	
	Above 45	19	2.68	.45098	
Race	Black	57	2.83	.62717	0.011**
	Coloured	4	2.00	.00000	
Type of dwelling	Brick house	35	2.66	.75618	0.113*
	Round house	7	3.19	.17817	
	Mud house	19	2.84	.42117	
Occupation	Farming	13	2.51	.50213	0.205*
	Non-farming	10	2.80	1.00860	

Socio-demographic characteristics		N (61)	Mean	Std. Deviation	P value
	Informal trading	7	2.57	.56811	
	Unemployed	31	2.92	.53548	
Highest level of education	Never attended school	2	2.67	.00000	0.679*
	Primary School	6	3.11	.34427	
	High School	17	2.84	.44281	
	Certificate	19	2.68	.82007	
	Diploma/Degree	11	2.61	.61134	
	Postgraduate	6	2.89	.86066	
Type of housing ownership	Own Property	20	2.82	.55646	0.102*
	Tenant	19	2.98	.80487	
	Other	22	2.56	.49747	
People living in household	Less than 3	12	2.89	.47849	0.248*
	4-6 people	24	2.58	.59181	
	6-8 people	16	2.98	.88165	
	More than 8	9	2.78	.28868	
Household average monthly income	Less than R1 000	13	3.05	.48774	0.213*
	R2 000-R3 000	23	2.72	.39762	
	R3 000 and more	25	2.68	.84152	
Household main source of income	Livestock	13	2.46	.42028	0.188*
	Crop production	17	2.94	.79263	
	Informal trading	4	2.83	.57735	

Socio-demographic characteristics		N (61)	Mean	Std. Deviation	P value
	Tourism	3	3.11	.38490	
	Social grants	20	2.87	.63430	
	Other	4	2.33	.38490	
Water source for farming	Rain water	16	2.88	.80623	0.204*
	River/ stream	16	2.88	.38249	
	Irrigation	21	2.54	.56250	
	Bore hole	8	3.00	.79682	
Source of household water supply	Indoor tap water	12	3.06	.88573	0.001**
	Yard tap	23	2.36	.47047	
	Shared Taps	22	3.02	.45399	
	No tap	2	3.33	.00000	
	River	2	2.67	.00000	
P* >5% P** <5%					

One-way ANOVA was performed to determine whether respondents differed in their responses regarding the statements measuring adaptability of water conservation techniques. The results are summarised in Table 4-13. The ANOVA value indicates that there was no statistically significant difference in the respondents' gender, age group, occupation, household average monthly income, the main source of income, water source for farming, type of dwelling, people living in household, highest qualification, and their adaptability to water conservation techniques (P>0.05). This suggests that regardless of the abovementioned demographic variables, their adaptability to water conservation techniques was the same.

On the hand other, the ANOVA value indicates that there was a significant difference in terms of the respondents' race and their adaptability to water conservation

techniques (P=0.011). The mean value measured for coloured respondents was the lowest (M=2.00 ± 0.000), while those found for Black respondents was the highest (M=2.83 ± 0.627). This suggests that coloured respondents were more adaptable to water conservation techniques.

In terms of the source of household water supply, the ANOVA test indicated that was a significant difference in their knowledge of water conservation techniques (P=0.001). The mean value measured for the respondents with yard tap (M=2.36 ± 0.470) was lowest while those with no tap was the highest (M=3.33 ± 0.000). This suggests that respondents with yard tap water supply were more adaptable to water conservation techniques.

4.6 PEARSON CORRELATION

The association existing among the water conservation variables (perception, knowledge and adaptability of water conservation techniques) were assessed using Pearson correlation, which is outlined in Table 4-14 below.

Table 4-14: Pearson correlation showing association among water conservation variables

		Perception water conservation	Knowledge water conservation	Adaptability water conservation
Perception water conservation	Pearson Correlation	1	.376**	.363**
	Sig. (2-tailed)		.003	.004
	N	61	61	61
Knowledge water conservation	Pearson Correlation	.376**	1	.475**
	Sig. (2-tailed)	.003		.000
	N	61	61	61
Adaptability water conservation	Pearson Correlation	.363**	.475**	1
	Sig. (2-tailed)	.004	.000	
	N	61	61	61
**. Correlation is significant at the 0.01 level (2-tailed).				

As shown in Table 4.14 above, there was a positive association between perception of water conservation and knowledge of water conservation techniques ($r=0.376$; $p<0.05$). A similar positive association was found between perception of water conservation techniques and adaptability of water conservation techniques. ($r=363$; $p<0.05$). This suggests that as the perception of the respondents' increases, their knowledge and adaptability of water-saving techniques increases and vice versa. Furthermore, knowledge of water-saving techniques correlates positively with the

adaptability of water conservation techniques and the association measured was strong (r=0.475; p<0.001).

4.7 NORMALITY P-P PLOT

Normality was evaluated by employing the normality P-P plot to assess the regression standardised residual (Lewinson, 2019). The P-P plot given in Figure 4-7 below showed that there is sufficient normality. There is visible evidence that the standardised predicted values and standardised residual form a straight line. Hence, it can be concluded that there is no major deviation from normality.

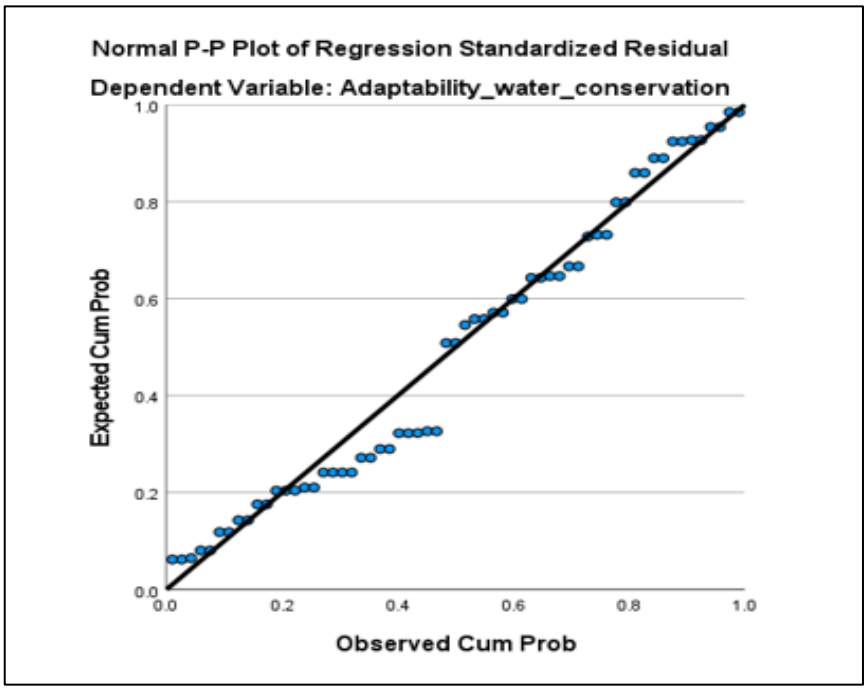

Figure 4-8: Normality assessment test using the P- P plot

4.8 MULTIPLE REGRESSION ANALYSIS

Multiple regression analysis (MRA) was performed to assess the predictors of the adaptability of water conservation techniques and is presented in Table 4-15 below. The perception of water conservation is represented as *"Predictor A"* while the knowledge of water conservation techniques is represented as *"Predictor B".*

Table 4-15: MRA showing the predictors of adaptability of water conservation techniques

Predictor	F-value	P-value	R	Beta coefficients	Error	R Square	Predicted	Significance	Collinearity statistics VIF
A	10.454	0.000	0.515	0.214	0.120	0.265	Adaptability of water conservation	0.083	1.165
B				0.394	0.119			0.002	1.165

As shown in Table 4-15 above, the F test suggests that that the model was statistically significant ($p<0.001$). The regression coefficient ($r=0.515$; $p<0.001$) suggests a strong causal relationship in the predicted model. The beta coefficient for knowledge of water conservation was a positive significant predictor while those measured for perception of water conservation techniques was positive but not significant. The R^2 values indicate that there was a robust explanatory power (26.5%) for the model predictors. Knowledge of water conservation techniques constitutes the only significant predictor of the adaptability of water conservation techniques. The data infers that there is no collinearity in the measured independent variable (predictor).

4.9 ADDITIONAL FEEDBACK FROM QUESTIONNAIRE

This section provides additional feedback to questions 25 (challenges) and 26 (recommendations) from the questionnaire, which were distributed to the participants. The recommendations are included in chapter 6 of the study.

4.9.1 Challenges Attributed to Water Conservation among Umgababa Farmers

The summary of challenges as provided by the respondents are as follows:

1. There is not enough water in the area. It is not clear from their feedback as to what was the cause of insufficient water in the area, whether it could be attributed to drought, or inadequate supply from the municipality.
2. Pipes are not serviced, which results in the stoppage of water after a while. There is also rust that comes out of pipes for days before the water can clear up and when in service. This implies that the condition of the piping system has deteriorated and requires routine maintenance from the municipality water service team.
3. Gardens/fields are dry, so the people of Umgababa are unable to plough and people now depend on rainwater during the rainy season. This situation becomes worse when there is no rain.
4. There is segregation between those that receive JoJo tanks and those who do not receive them. There is no systemic approach used for the distribution of these tanks, hence there appears to be varying degrees of favouritism in the distribution of the JoJo tanks.
5. Not much education on water conservation is provided to the people. In order words, the level of awareness is still very low which indicates that much work is still required.

SECTION B: QUALITATIVE DATA ASSESSMENT

This section sought to assess the findings from the interviews with the five (5) interviewees who participated in this study.

4.10 PARTICIPANTS

The interview forms were given to five (5) participants who work at the Department of Water and Sanitation (DWS), out of which three (3) participants completed the interview. The interview session lasted for about 30 minutes and the feedback from the interviewees were transcribed and transferred to a word document.

4.11 SUMMARY OF THEMES

Table 4-16 below outlines the findings from the study analysis, which are provided in form of themes.

Themes Description:

Job Titles: The job titles refer to the roles, functions and duties of the participants within the department of water and sanitation. This is classified under sub-themes as “Job function at DWS”.

Employment Duration: This addresses how long the interviewee has been in the employ of DWS and the sub-theme is classified as “duration of employment at DWS”.

Positive Perception: This theme refers to the positive awareness and insight of the participants towards water conservation and preservation.

Perceptions on water conservation: This theme addresses the view that is currently prevalent among rural household members in the Umgababa area.

Approaches and Strategies: This deals with the methods and stratagems that the participants intend to take that are valuable for water conservation practice.

Prevailing and Predominant Practice: This theme refers to the common practices around water conservation that are typically obtained in the Umgababa rural areas. This is illustrated under sub-themes as “Predominant water conservation practices used by rural household”.

Sustainability: This particular them deals with the ability of water conservation practices to be maintained and sustained in the Umgababa rural community by local farmers. The sub-theme is presented as “Sustainability of water conservation practices”.

Adaptability: This refers to the ability of the water conservation method or technique to be adjusted to varying conditions within the Umgababa community. This sub-theme is represented as “degree of water conservation techniques adaptability”.

Measures of Promoting Conservation: This main theme revolves around different approaches and means that the DWS can use towards the promotion of water conservation techniques.

Practicable Recommendations: This main theme refers to feasible and realistic things that the rural farmers in the Umgababa community can use towards the sustenance of water conservation.

Table 4-16: Summary of Themes

Main Themes	Sub-Themes
Job titles	Job function at DWS
Employment duration	Duration of employment at DWS
Positive perception	Positive perception of water conservation by South Africans
Perceptions on water conservation	Perception of water conservation among rural household members in Umgababa
Approaches and Strategies	Approaches and strategies in place for good water conservation practice
Prevailing and Predominant Practice	Predominant water conservation practices used by rural household
Sustainability	Sustainability of water conservation practices
Adaptability of techniques	Degree of water conservation techniques adaptability
Measures of promoting conservation	Measures DWS used in promoting water conservation techniques
Practicable recommendations	Practical recommendations for sustainable water conservation culture among rural communities

4.12 CONCLUSION

This chapter presented the findings and results obtained from the questionnaires and interviews. The first section of the chapter outlined the quantitative data outcomes, which were presented in the form of descriptive and inferential statistics. The second section covered the feedback of the interviewees with regards to the semi-structured interviews. The chapter also outlined the vivid patterns from the data analysis. The next chapter presents the study conclusion and recommendations from the study.

CHAPTER 5
DISCUSSION OF RESULTS AND FINDINGS

5.1 INTRODUCTION

The previous chapter presented the results and findings from this study. This chapter outlines the findings from both the quantitative and qualitative outcomes in comparison with the literature. This chapter also addresses how the study agrees or disagrees with the literature of the study.

5.2 PERCEPTION OF WATER CONSERVATION

The response of the respondents on *whether farmers are required to have a positive perception of water conservation techniques* revealed that the majority of the respondents agreed with the statement. Even though the perceptions of water conservation vary in many regions globally (Noga & Wolbring, 2013; Atari, 2014), the feedback from the respondents agrees with the study literature. As highlighted by Gholson et al. (2019), when the perception of residents in a given place is negative, the farmers in such residential areas are usually reluctant to pay attention to water conservation. Also, the feedback from the interviewees showed that rural farmers and South Africans have a positive perception of water conservation, as they had this to say:

*"As Umgababans I think we generally do and have a water conservation demand management awareness. Many of us have experienced drought, and that has certainly increased the awareness of all the folks". …**R1***

*"Rural Umgababans positively perceive the importance of water conservation as they do mostly farming as a form of sustainability and require water, hence the need to conserve water". …**R3***

Umgababans have a positive notion on conserving water for farming purposes, and due to long distances travelled to obtain water from the streams and dams, hence

*has resorted to water harvesting such as installation of JoJo tanks and boreholes". …**R3***

This further strengthens the view that difficult times with regard to water scarcity demands a change of approach by farmers in rural communities (Weiss, 2019).

Among other measures, an awareness campaign is required to address the lack of water conservation ideology, especially where such views are poor (Manomano & Tanga, 2018). The findings from this study showed that the majority of the respondents were in agreement that *the DWS provide awareness campaigns on water conservation techniques in farming*. Awareness campaigns and other measures are required to redress this concern alongside other communities that do not have a positive perception regarding water conservation (Weiss, 2019). However, the feedback of the respondents to question 25 on the questionnaire revealed that not much education is provided to the communities on water conservation. In essence, this casts some doubt as to how the Umgababa community education on water conservation is carried out.

The feedback of the respondents to the statement *"the Umgababa farming community has a good conservation culture"* showed that they neither agreed nor disagreed with the statement, as the mean value measured for the statement was close to indifferent. One can assume with this response that there is no clear pattern as to how the culture of water conservation is across the community. Marin et al. (2017) stress the needfulness of promoting a positive water conservative culture among households. In addition, the needfulness of promoting a water conservation culture is vital because of the decline in water availability across the globe.

The findings from the study also showed that other demographical factors reviewed by the scholar such as race, occupation, household average income, the main source of income, water source for farming and source of household water supply had no impact on the farmers' respective perception of water conservation.

However, it was noted that female respondents agreed more with statements around perception of water conversation than males.

5.3 WATER CONSERVATION TECHNIQUES

Across the globe, diverse water conservation techniques are being adopted by farmers. The effectiveness of these techniques, however, depends largely on the climatic condition of the environment and the level of technological advancement in the area (Sawadogo, 2011). The response of the respondents showed that farmers have *adequate knowledge on water conservation techniques*. A strong understanding of the conservation techniques is usually preferred to general knowledge (Johnson, 2017). It is believed that a strong understanding of conservation practices will enable farmers to implement sustainable initiatives that will increase their output in agricultural production (Water Europe, 2013). Sufficient knowledge of water conservation methods and techniques play a vital role in subsistence farming. It has also been said that the absence of this knowledge limits the willingness of farmers to become more involved in water conservation methods (Oremo, et al., 2019). As revealed by a study in Kenya rural farmers that had more knowledge of water conservation techniques were more open to farmers' networks and were involved in initiatives such as agricultural extension services (Oremo, et al., 2019). This further revealed that farmers who were isolated miss out on such valuable information, that have the potential of increasing their agricultural yield through improved water conservation techniques.

A closer review regarding how the demographics of the respondents affects water conservation techniques revealed some salient points. Parameters such as gender, age group, race, occupation, type of residence had no impact on water conservation techniques as there was no statistical difference. A different pattern was observed on parameters such as the highest level of education and other sources of income.

For example, the study by Oremo et al. (2019) assessed how the farmers' level of education affects their knowledge of water conservation techniques, thus indicating a direct relationship. Amazingly, the findings from the research in this study showed that respondents with postgraduate qualifications had more knowledge of water conservation techniques in comparison to less-educated participants. Comparing the primary findings from this study, Oremo et al. (2019) shows that a farmers' level of education positively influences their knowledge of water conservation techniques. Oremo et al. (2019) also outlined that more affluent farmers with more streams of income had better knowledge of water conservation methods, thus confirming the findings from this primary data. Therefore, it can be safely concluded that Umgababa farmers who are better off financially and had other sources of income had better knowledge of water conservation techniques.

The feedback also showed that more of the respondents neither agreed nor disagreed with the statement *"water conservation techniques are widely adopted by farmers in Umgababa"*. However, this study did not expand on the reasons surrounding why water conservation techniques have or have not been widely accepted by Umgababa farmers. Numasawa (2014) revealed that some of the techniques and initiatives have not been adopted by rural farmers, due to the financial constraints, lack of skills and poor infrastructure in place. Based on the structure of the question used in gathering the primary data, it would be inappropriate to assume that the respondents' neutrality to these questions means that water conservation methods are rarely adopted by Umgababa rural farmers. In general, it can be inferred that the water conservation techniques are poorly used in Umgababa. This is also supported by the study of Nhemachena et. al (2020) that highlighted that the introduction of water conservation practices and techniques are still very low in many rural communities, regardless of the encouraging effects to motivate SA farmers towards water conservation.

Subsistence farmers in India have adopted several diverse techniques in sustaining crops during drought seasons (Wolka, et al., 2018). For instance, one of the diverse conservation techniques used in India is the percolation tank, which revolves around the use of a small reservoir to capture rainfall runoff and subsequently applying it to the farms when needed (Wolka, et al., 2018). In addition, subsistence farmers in Burkina Faso and Niger have adopted water conservation techniques (Abdul-Hanan, et al., 2014). Hence, it may be necessary for more studies to be undertaken to uncover how to increase and expand the adoption of water conservation techniques in Umgababa.

5.4 ADAPTABILITY OF WATER CONSERVATION TECHNIQUES

The feedback to the statement *"water conservation techniques used by Umgababa farmers are sustainable"* showed that more of the respondents were closest to neutral and indifferent in their response. The Water Services Act of 1997 and the National Water Act (NWA) of 1998 provides a framework for sustainable water resource management, which indicates the necessity of sustainable water conservation techniques.

The feedback of the interviewees as to whether water conservation practices used at Umgababa were sustainable showed that respondent (R1) believed that sustainability comes from self-awareness while respondent (R2) indicated that sustainability comes from the fact that water is saved, thus reducing how much is paid forward. They had the following to say.

*"I guess it is sustainable from the perspective that it is self-awareness practice. It is not something that we have promoted. However, I believe that there is sustainability and at this stage is self-sustaining" …**R1***

*"Strategies or initiatives for eThekwini are sustainable because when people save water, there is an incentive as they pay for the water usage" …**R2***

*“To a certain extent they are, but all dependent on the usage of water and the number of members per household” …**R3***

As highlighted by Abdullahi et al. (2017), many sources of water conservation are unsustainable, which signifies that the finding from this study is not a stand-alone occurrence. In addition, the feedback of the respondents to this statement showed that more improvements are required in ensuring that the water conservation techniques used in Umgababa are sustainable. This approach should be pursued, as it is in line with the adoption of sustainable water conservation techniques which has become a national development policy discourse in South Africa (Agholor & Mzwakhe, 2020). The findings from this study showed that it is imperative for SA to focus more on the sustainability of water conservation for farmers, such as the adoption of best practices from countries such as Israel. Futran (2013) stressed that their reputation for being frontrunners in water conservation was realised through many years of research and policy execution aimed at sustainable water conservation practices. As a result, many developed and emerging economies are embracing the principles behind their success stories.

The statement *“the farmers of Umgababa are beginning to adopt sophisticated water conservation techniques”* received mostly close to the neutral response. In other words, more of the respondents neither agreed nor disagreed with the statement. The review of literature in this study showed that most of the water conservation practices such as mulching, rainwater harvesting, contour ridges and terraces are techniques that are not easily adopted by subsistence farmers (Agholor & Mzwakhe, 2020). Issues such as unstable agricultural policies, scanty knowledge of known conservation practices and availability of funds drive the use of conservation practices (Nhemachena, et al., 2020). However, the above mentioned sophisticated techniques are used in SA where the wherewithal is in place, and the proportion that utilises this is quite low (Nhemachena, et al., 2020). Sophisticated water conservation techniques are known to generate employment opportunities

(Water Europe, 2013), which would have been a welcoming development for the South African economy if commonly practised. Additional benefits of sophisticated water conservation techniques include increased output in agricultural production and improved standard of living (Water Europe, 2013). As highlighted by Kanu et al. (2014), many underdeveloped nations are unable to adopt sophisticated water conservation practices due to financial constraints, lack of required skills and poor infrastructure. In summary, the neutrality and uncertainty of the respondents to this statement can be safely concluded that Umgababa farmers are far off from adopting sophisticated water conservation techniques.

On the contrary, the respondents strongly agreed with the statement that *"farmers of Umgababa use traditional water conservative techniques".* This suggests that basic water conservation techniques, such as the use of JoJo tanks and boreholes were well-acquainted practices in Umgababa. This is also supported by the ranking of adaptability of water conservation techniques, which revealed that the extent of water conservation techniques in Umgababa is well adaptable. This study ranked the water conservation techniques used by farmers in Umgababa. The outcome of this assessment revealed that the extent of water conservation techniques adaptability was satisfactory. Further assessment which compared the demographics to water conservation techniques adaptability revealed that there was no statistical difference among all demographic parameters and their adaptability to water conservation techniques.

5.5 APPROACHES AND STRATEGIES FOR GOOD CONSERVATION PRACTICE

The responses of the interviewees to the approaches and strategies DWS has put in place to ensure good conservation practices (culture) revealed the province has extensive educational programmes and is also working with diverse service bodies

to increase water conservation knowledge. Campaigns such as roadshows are also organised to increase water conservation awareness. They had the following to say.

*"The Directorate run extensive schools' education programmes, and they are also interacting with the district forum structures. Our department also works very closely with the various service authorities on the water conservation and demand management programme". …**R1***

*"DWS has a community education division that has roadshows in trains, schools, taxi rank etc., explaining that people should save water and reporting leaks, giving out the toll-free number they would call if such happens". …**R2***

*"EThekwini Municipality Water & Sanitation (EWS) has invested in the installation of JoJo tanks in rural communities and schools. They also have Educational Officers that travel to schools and communities to educate residents about water conservation". …**R3***

In addition, below is the feedback of the interviewees regarding the measures that DWS has used in promoting water conservation techniques among rural farmers.

*"There are primarily awareness and education campaigns, such as our school's programme, our water week programme, participation in Inter-Governmental Relations (IGR) and inter-governmental relations. In fact, at the request of the premier, there has been a very strong collaboration with an effort led by and supported by the DWS and other key departments, where we developed a provincial master plan for Provincial water that speaks to the issue of implementing water use efficiency and dealing with water conservation and demand management". …**R1***

*"The deployment of Education Officers to communities and schools to educate the public, in addition to the issuing of booklets and flyers. The DWS has included water conversation in the educational curriculum for certain subjects in school such as Agriculture". …**R3***

The feedback from respondents (R1 and R2) supports the perspective of awareness, education campaigns, government promoted initiatives and communication from government officers. In essence, a change of mindset should be the end goal that will ultimately infuse the residents with a new culture.

It has been revealed that campaigns on conservation often have positive effects on conservation behaviours, which ultimately impacts water quality (Dolnicar, et al., 2012). Previous investigations into the effects of such campaign strategies have shown that roadshows and campaigns promote public awareness, thereby improving water conservation culture (Moglia, et al., 2018). In general, the focus during such initiatives and campaigns is to target successful long-term outcomes, instead of immediate results (Moglia, et al., 2018).

5.6 PREDOMINANT WATER CONSERVATIVE PRACTICES USED BY RURAL HOUSEHOLD MEMBERS

The feedback of the interviewees on predominant water conservative practices used by rural householders in KwaZulu-Natal revealed that most of the water conservation practices are basic. They had the following to say.

*“There is the use of JoJo tanks, which is a strong practice that is to conserve water during difficult times”. …**R2***

*“Water harvesting from the rain via JoJo tanks and boreholes”. …**R3***

The findings from interviewees showed that the current predominant and prevailing practices are basic methods of water conservation such as water harvesting via JoJo tanks and boreholes. Agholor and Mzwakhe (2020) revealed that most subsistence farmers rarely engage in other water conservation techniques such as mulching, rainwater harvesting, contour ridges and terraces. It is further believed

that limitations such as inadequate knowledge of water conservation and lack of funds limit farmers to basic water conservation methods (Nhemachena, et al., 2020).

5.7 CONCLUSION

This chapter outlined the discussion of the results and findings. These discussions were presented under different headings; ranging from the perception of water conservation, water conservation techniques, adaptability of water conservation techniques, approaches and strategies for good conservation practice, predominant water conservation practices used by household farmers. The next chapter presents the conclusions and recommendations of this study.

CHAPTER 6
CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

The outgoing chapter outlined the discussion of the results and findings from this study. The intention of this study was to investigate the perception of Umgababa community household farmers towards water conservation. This last chapter presents a summary of the outcomes under each of the study objectives, conclusions, recommendations, study limitations and suggestions for future study.

The study objectives are presented below

- To identify the water conservation techniques used in the Umgababa community;
- To determine if the water conservation methods used are adaptable;
- To determine the extent of adaptability of the water conservation techniques used in the Umgababa community, and
- To recommend guidelines towards sustainable water conservation techniques.

6.2 SUMMARY OF FINDINGS

6.2.1 Objective 1: To identify the water conservation techniques used in the Umgababa community

The review of the literature highlighted that other water conservation techniques such as mulching, rainwater harvesting, contour ridges and terraces were not techniques that are easily adoptable in rural and subsistence farming (Agholor & Mzwakhe, 2020). Although the above-mentioned methods are used in South Africa where the requirements are in place (Nhemachena, et al., 2020), it was revealed that the core water conservation techniques and practices used in the Umgababa

community are JoJo tanks and boreholes. These are the most basic water conservation techniques that a smallholder farmer can easily undertake.

6.2.2 Objective 2: To determine if the water conservation methods used are adaptable

Water conservation adaptability was assessed under three aspects. The first aspect dealt with evaluating whether the techniques used by Umgababa farmers are sustainable. The feedback of the respondents to the quantitative assessment showed neutrality in response. On the contrary, the feedback from the interviewees suggested that sustainability exists in the current water conservation practices. The outcome of the survey revealed that more improvements might be required in making sure that water conservation methods and techniques used in Umgababa were sustainable. Hence, existing techniques fall short of adaptability. For instance, the use of JoJo tanks mostly depends on saving water by entrainment during rainfall. The absence of rain during the summer months implies that JoJo tanks would be of no value as would be no rain to fill up such tanks. Also, the use of boreholes would be adaptable and sustainable if the farmland is owned by the subsistence farmer. In a case where the farmland belongs to another, and the farmer is temporarily using the land.

Secondly, another angle that was assessed was whether Umgababa farmers were beginning to adopt sophisticated water conservation techniques. This refers to techniques such as mulching, reservoir/valley dam, terracing and tied-ridging. It was observed that most of the respondents neither agreed nor disagreed with the statement, indicating more of a neutral response. As a result, it is safe to conclude that these sophisticated and refined methods are not common to the Umgababa farming community, hence not adaptable.

Finally, the last aspect investigated whether the farmers of Umgababa used traditional water conservation techniques. The outcome of the respondents revealed

that most of the respondents strongly agreed with the statement. It also validated that the prevalent water conservation methods are the use of JoJo tanks and boreholes.

6.2.3 Objective 3: To determine the extent of adaptability of the water conservation techniques used in the Umgababa community

The assessment regarding the extent of adaptability of the water conservation techniques applied at Umgababa area revealed that a larger proportion of the respondents ranked the degree of adaptability very high. This means many of the participants believe that the method currently used is workable and can be multiplied in the community. As highlighted by Chakravarty et. al (2012), it is essential for the rural communities to adapt these techniques in order to obtain adequate water quantities required for farming purposes. In summary, it is safe to submit that the extent of adaptability for water conservation methods is very high.

6.3 CONCLUSIONS

The conclusions from this study are as follows:

a. **Umgababa farmers have a positive perception of water conservation techniques.** Perception deals with the belief and opinion that an individual possesses about a thing. A review of the literature with regards to water conservation showed that negative perception by a farmer gives rise to a degree of reluctance (Gholson, et al., 2019). The findings from the respondents showed that many rural farmers understand water conservation, as they have experienced drought directly or indirectly, which has also increased water conservation awareness. Another aspect of the findings also revealed that rural farmers have a positive notion of conserving water for farming purposes and have had a fair share of the difficulties when water is

absent. However, this study did not cover the metric around the degree of perception and how this can be measured or monitored.

b. **DWS provides awareness campaigns on water conservation techniques in farming.** The review of the literature showed that an awareness campaign is needed to address the lack of water conservation ideologies, especially where such views are poor among rural farmers (Manomano & Tanga, 2018). The trend of the study outcomes showed that most of the respondents agreed that the DWS provides the necessary campaigns and awareness forums to improve the water conservation methods of Umgababa rural farmers. Some awareness initiatives are carried out in form of town hall meetings and educational community outreach programmes. As further highlighted by Noga and Wolbring (2013), a major means of improving water conservation is by educating the residents. Nevertheless, it is essential for DWS to increase these awareness initiatives and even put in place a means of monitoring corresponding effectiveness. In so doing, it will be easy to determine whether such campaigns have achieved the expected goals. Primary awareness and educational campaigns such as school programmes, water week programmes, inter-governmental relations, deployment of education officers to communities and inclusion of this awareness into public schools should be maintained. DWS and the Department of Agriculture's collaboration, is vital in achieving this outcome.

c. **There was hesitancy in the feedback of the respondents regarding the community having a good water conservation culture.** Noga and Wolbring (2013) emphasised the value of promoting a positive water conservation culture among households. The feedback of the study participants revealed neutrality towards whether the Umgababa farming community maintained a good water conservation culture. Their hesitancy to respond implies that the participants were not convinced by the water

conservation culture prevalent in the community. It is necessary to promote a strong water conservation culture due to the decline of fresh water across the globe. Water conservation needs to be seen as adding value to livestock and crop production. Better water conservation techniques will improve crop yields and benefit farmers. Adimassu, Langan, Johnston, Mekuria and Amede (2019) in the study that assessed the impacts of soil and water conservation practices on crop yield revealed a positive correlation between water conservation practices and crop yield. An approach of consistent soil and water conservation practices enabled the researcher to attain a positive outcome (Adimassu, et al., 2017). A similar view and outcome were also proposed by Traore, Barro, Yonli, Stewart and Prasad (2020), in a study that investigated water conservation methods and cropping systems for increased productivity and economic resilience in Burkina Faso. The result from this study showed that water conservation improves cropping system productivity and revenue (Traore, et al., 2020).

d. **The farmers have basic knowledge on fundamental water conservation techniques.** The fundamental water conservation techniques utilised by Umgababa farmers as highlighted in this study are JoJo tanks and boreholes. This knowledge is considered basic, as a stronger understanding of water conservation techniques is usually preferred to general knowledge (Johnson, 2017). It is generally believed that such deep understanding will enable farmers to introduce sustainable initiatives that will multiply agricultural output (Water Europe, 2013). Oremo et al. (2019) also highlighted that the absence of adequate knowledge limits the willingness of rural farmers to become more involved in water conservation methods. It is essential for farmers to expose themselves to farmers' networks and be part of available agricultural extension services. The study by Oremo et al. (2019) showed that when farmers isolate themselves, they miss out on networking abilities that increase their knowledge on current trends in terms of water conservation developments and best global practices.

e. **Water conservation techniques used by the Umgababa farmers are not sustainable.** Participants from the community provided responses that suggests neutrality while responses by predominantly government workers stated the opposite. The neutral response of the survey respondents showed that additional improvements might be required to instil confidence in the participants on future questions. For example, the use of JoJo tanks mostly depends on saving water by entrainment during rainfall. The absence of rain indicates that such tanks would be of no value. Additional engineering modification to utilise these JoJo tanks beyond basic use might be required, such that additional value can be derived from the tanks. In addition, the adaptability of the borehole is limited if the farmland is not owned by their farmer as their degree of freedom for land use is limited. However, it might be necessary to investigate how these sustainability views are actually monitored in the community.

f. **This study showed that sophisticated water conservation techniques are at not present being adopted or utilised in the Umgababa community.** The term sophisticated water conservation technique refers to practices such as mulching, rainwater harvesting, contour ridges and terraces (Wambede, et al., 2019). Other advanced aspects of the sophisticated water conservation practices include irrigation technology, reduced evaporation, rainwater catchment from high tunnels, tail water return systems and improved furrows. As much as mulching, and rainwater harvesting, amongst other methods, are used in other developed nations, they are presently not applied by subsistence and smallholder farmers in the Umgababa community.

g. **The extent and degree of water conservation adaptability is high.** The idea behind adaptability deals with the potential of being able to adjust to new conditions or to be metamorphosed for new use. It was conclusively

uncovered that the participants consider a higher level of possible adaptability. Hence, the existing water conservation practices are adaptable and can be replicated within the Umgababa community. Chakravarty et. al (2012) opine that subsistence farmers in rural areas should adopt these techniques in order to actualise the targeted water volumes and corresponding quantities. In essence, it can be submitted that the extent of adaptability for water conservation for the Umgababa community is high.

6.4 RECOMMENDATIONS

The recommended guidelines towards sustainable water techniques are as follows:

a) **Improved Awareness on Water Conservation by the Department of Water and Sanitation:** Efforts should be made by DWS to continue the current awareness campaigns and other associated initiatives presently carried out by the provincial government. A previous study by Olayemi and Nirmala (2016) revealed that some of the challenges of water conservation revolves around the weak understanding of methods. It was found in this study, that DWS currently provides an awareness campaign, but that more work is needed in this area to realise a community that is aware of the importance of water conservation and knows how to accomplish it. It is necessary for DWS to devise a plan or means of measuring the effectiveness of the awareness campaigns and reviewing continuous feedback from the community. A more realistic outcome than what is currently achieved can be realised with such metrics in place. Primary awareness and educational campaigns such as school programmes, water week programmes, inter-governmental relations, deployment of education officers to communities and inclusion of this awareness into public schools should be inculcated in the awareness campaign plan.

b) **Strategic "Hands-on" Training of Farmers on Water Conservation through Government Partnership:** Aside from adequate awareness campaigns, hands-on training is strongly recommended for subsistence farmers. This implies that it is needful for them to be involved in some sort of field training by experts in basic water conservation techniques. It is has been suggested that collaboration between subsistence and smallholder farmers and subject matter experts via government partnerships assist in improving the hands-on experience of the farmers (Pesanayi & Weaver, 2016). Period training and collaborative field tasks with agricultural extension workers also help in improving the expertise of smallholder and subsistence farmers towards adequate water conservation abilities (Bakre & Dorasamy, 2016). Collaboration and joint field learning are essential to improving the confidence of local farmers. Agricultural extension officers can also assist in setting up such collaborative platforms between government and farmers, where the farmers' skills will be sharpened for improved execution of basic water conservation techniques.

c) **Maintenance of Existing Water Supply Infrastructure:** This study revealed that there are maintenance shortfalls that exist on the current piping networks. It is highly recommended that the current piping network be maintained and serviced by DWS, in order for the Umgababa community to maximise the existing supply of water to the area. This is vital as the further breakdown of water infrastructure creates further difficulties and hardship for subsistence farmers.

d) **Investigation of other Water Conservation Practices:** It is also recommended that other commonly used water conservation practices that are applied in SA, such as shift cultivation, rainwater harvesting, planting without ploughing and mulching should be explored and implemented. This will increase the diversity of water conservation practices available in the Umgababa community for subsistence and smallholder farmers.

(Udidi Project Development, 2009)

6.5 SUGGESTIONS FOR FUTURE STUDY

It is recommended that a similar study should be carried out to compare the water conservation techniques in other surrounding communities. Empirical studies should be carried out by the DWS, to statistically analyse and understand what rural communities across KwaZulu-Natal are doing in terms of water conservation, its adaptability and sustainability. These suggested studies will enable the government to understand where the current gaps lie and how to address such voids, in order to revive income and revenue growth among rural communities.

6.6 CONCLUSION

This chapter concludes this study. It was highlighted in this chapter that the core water conservation techniques applied are the use of JoJo tanks and boreholes. This study revealed that the existing water conservation techniques used in Umgababa community are stable; however, these techniques are very basic in nature. It was also revealed that the extent of water conservation techniques adaptability was quite high. This was an in-depth study and substantial analysis was done to assess the findings from the data collection. (Google Maps, 2020)

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APPENDIX A

Questionnaire - Quantitative

(NB: This will be also translated in IsiZulu)

QUESTIONNAIRE

PREAMBLE

Dear participant, this research intends to obtain an insight into perception of water conservation among household members of Umgababa. Your identity will not be disclosed, as the aggregate response of all respondents will be used to make informed judgement.

SECTION A: DEMOGRAPHICS OF PARTICIPANTS

1. Gender

Male	Female

2. Age bracket

Below 20	21-25	26-35	36-45	Above 45

3. Race

Black	White	Coloured	Indian

4. Type of dwelling

Brick house	Round house	Mud house	Shack

5. **Occupation**

Farming	Non-farming	Informal trading	Unemployed	Others (Please specify)

6. **Highest level of education**

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

7. **Type of housing ownership you have**

Own Property	Tenant	Other

8. **People living in your household**

Less than 3	4-6 people	6-8 people	More than 8

9. **Household's average monthly income**

Less than R1000	R2000-R3000	R3000 and more	Other(please specify)

10. **Household's main source of income**

(You can tick as many options as possible)

Farming		non-farming activities			
Livestock	**Crop production**	**Informal trading**	**Tourism**	**Social grants**	**Others (Please specify)**

11. Water source for farming

Rain water	River/ stream	Irrigation	Bore hole	Others (Please specify)

12. Source of household water supply

Indoor tap water	Yard tap	Shared Taps	No tap	River

SECTION B: PERCEPTION OF WATER CONSERVATION

13.Farmers are required to have a positive perception of water conservative techniques

Strongly Agree	Agree	Indifferent	Disagree	Strongly disagree

14.The Department of Water and Sanitation provides awareness campaigns on water conservation techniques in farming

Strongly Agree	Agree	Indifferent	Disagree	Strongly disagree

15.The Umgababa farming community has a good water conservation culture

Strongly Agree	**Agree**	**Indifferent**	**Disagree**	**Strongly disagree**

SECTION C: WATER CONSERVATION TECHNIQUES

16. Indicate with a tick which water conservation techniques you are familiar with

Rain harvesting	**Flood Management**	**Rational use of groundwater**	**Redistribution of water**	**Change in crop pattern**	**Others (Please specify)**

17. I have adequate knowledge on Water conservation techniques?

Strongly Agree	Agree	Indifferent	Disagree	Strongly disagree

18. The farming community of Umgababa have a good understanding of water conservation techniques?

Strongly Agree	Agree	Indifferent	Disagree	Strongly disagree

19. Water conservation techniques are widely adopted by farmers in Umgababa?

Strongly Agree	Agree	Indifferent	Disagree	Strongly disagree

Section D: Adaptability of Water conservation techniques

20.Rank from *one-five*, the extent of adaptability of water conservation techniques used in Umgababa?

Extremely adaptable	Always Adaptable	Adaptable	Occasionally adaptable	Not adaptable
1	**2**	**3**	**4**	**5**

21.The water conservation techniques used by Umgababa farmers are sustainable?

Strongly Agree	Agree	Indifferent	Disagree	Strongly disagree

22. The farmers of Umgababa are beginning to adopt sophisticated water conservative techniques?

Strongly Agree	Agree	Indifferent	Disagree	Strongly disagree

23.The farmers of Umgababa use traditional water conservative techniques?

Strongly Agree	Agree	Indifferent	Disagree	Strongly disagree

Section E: Challenges

24. Explain challenges attributed to water conservation among Umgababa farmers?

_____

Section F: Recommendations

25. Provide recommendations on how to improve water conservation among Umgababa farmers?_____

APPENDIX B

Interview - Qualitative

1. Describe your role at the Department of Water and Sanitation?

2. How long have you been in the Department of Water and Sanitation?

3. Will you say South Africans have a positive perception of water conservation?

4. Describe your perception of water conservation amongst rural household members of South Africa

5. What approaches or strategies have your department put in place to ensure a good water conservation practice (culture)?

6. What would you consider to be the predominant water conservative practices used by rural household members of South Africa (KZN)?

7. In your opinion, are these water conservative practices sustainable?

8. In your experience, to what extent are the water conservative techniques adaptability?

9. Explain measures the Department of Water and Sanitation has used in promoting water conservative techniques among rural communities?

10. What practicable recommendations may ensure a sustainable water conservative culture among rural communities?

APPENDIX C

Gate Keeper's Letter

water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

30 May 2021

Department of Water and Sanitation
85 Field Street
Durban

Permission to Conduct Research in EThekwini Municipality

Dear Ms. Geli Thabethe

We acknowledge receipt of your correspondence dated 12 May 2021, requesting permission to conduct interviews towards your Masters studies in Public Administration with the Durban University of Technology.

The Department of Water and Sanitation hereby grants you the permission to conduct the requested research and agrees to offer assistance where it may be required.

Hope you will find this in order

Yours sincerely

Mr. Michael Singh

Director: Water Resources Support
KwaZulu-Natal

APPENDIX D

Ethical Clearance Approval

MANAGEMENT SCIENCES: FACULTY RESEARCH ETHICS COMMITTEE (FREC)

3 March 2020

Student Name: **Ms GS Thabethe**
Student No: 16638614

Dear Ms GS Thabethe

MASTER OF MANAGEMENT SCIENCES: PUBLIC ADMINISTRATION

TITLE: Farmers' perception on water conversation: A case study of the Umgababa community, Kwa Zulu-Natal

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

Date of FRC Approval: 3rd March 2020

Approval has been granted for a period of two years from the above FRC date, after which you are required to apply for safety monitoring and annual recertification. Please use the form located at the Faculty. This form must be submitted to the FREC at least 3 months before the ethics approval for the study expires.

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

Yours sincerely

_____

Prof JP Govender
Chairperson: Faculty Research Ethics Committee

APPENDIX E

Turnitin Report

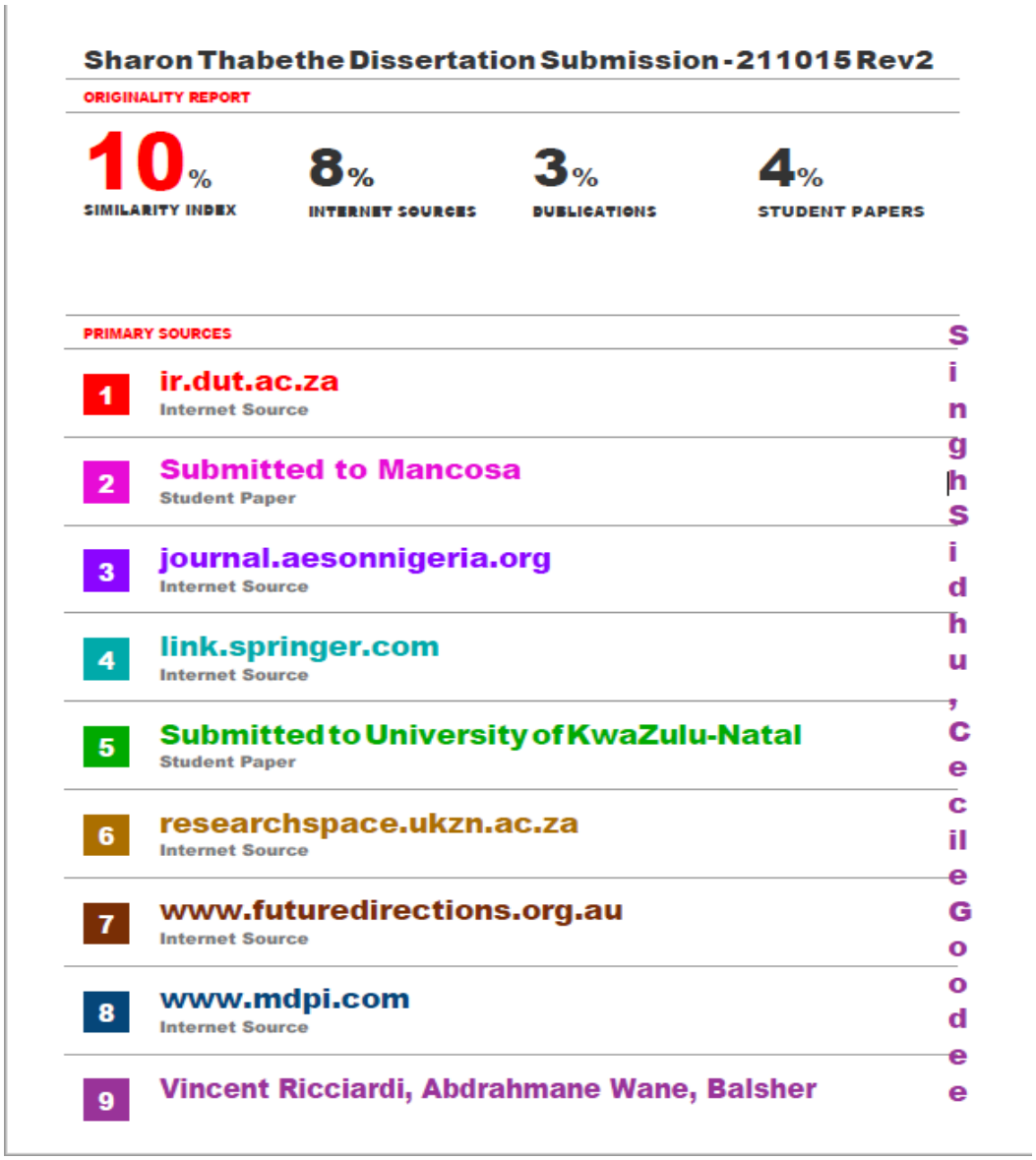
Sharon Thabethe Dissertation Submission - 211015 Rev2

by Sharon Thabethe

Approved Turnitin Report

Supervisor: Dr J S Davis

Submission date: 15-Oct-2021 03:31AM (UTC+0200)
Submission ID: 1674153932
File name: Sharon_Dissertation_-_Turnitin_Submission_2_211015.docx (969.44K)
Word count: 24907
Character count: 141030



Sharon Thabethe Dissertation Submission - 211015 Rev2

ORIGINALITY REPORT

10%	8%	3%	4%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	ir.dut.ac.za Internet Source	
2	Submitted to Mancosa Student Paper	
3	journal.aesonnigeria.org Internet Source	
4	link.springer.com Internet Source	
5	Submitted to University of KwaZulu-Natal Student Paper	
6	researchspace.ukzn.ac.za Internet Source	
7	www.futuredirections.org.au Internet Source	
8	www.mdpi.com Internet Source	
9	Vincent Ricciardi, Abdrahmane Wane, Balsher	

Singh Sidhu, Cecile Goodee

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	farmers in water scarce regions", Nature Sustainability, 2020 Publication	
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APPENDIX F

Editing Report

Sury Bisetty Academic Editing Services –

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To whom it may concern,

I have edited the dissertation entitled: An Investigation of a Farmer's Perception of Water Conservation: A Case Study of the Umgababa Community by GS Thabethe, Student number: 16638614 submitted in partial fulfilment of the requirements for the degree Master of Management Sciences: Public Administration and Management, Department of Public Management & Economic, Faculty of Management Sciences at the Durban University of Technology.

Sury Bisetty
Language and Technical Editor 2
November 2021

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Disclaimer: Please note I provided language and technical editing as per discussion with the client. The content of the report/thesis was not amended in any way. The edited work described here may not be identical to that submitted. The author, at his/her sole discretion, has the prerogative to accept, delete, or change amendments/suggestions made by the editor before submission.

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