DETERMINANTS OF HOUSEHOLD ACCESS TO AND PERCEIVED QUALITY OF WATER IN SOUTH AFRICA.

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APRIL 2022

DECLARATION

I hereby declare that this Master's thesis entitled "*Determinants of household access to and perceived quality of water in South Africa*" is my own work, and that I have not previously submitted it at any university for a degree or examination. All sources that I have quoted have been indicated and duly acknowledged by means of referencing.

Signature

Comfort Oritsebemigho Oyowe

April, 2022.

At the University of the Western Cape

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I would like to thank Almighty God for his grace and mercy and our blessed mother Mary for always interceding on my behalf. Thank you Lord for love, hope and faith.

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MODOKPE!

DEDICATION

To God Almighty the giver of all that is good.

To the obstinacy of those experiencing inadequate access to potable water, you will be heard.

To my parent, the Late Mr John Agboghoroma Oyowe, Mrs Mabel Oyowe and guardian Professor Anthony Oritsegbubemi Oyowe.

ABSTRACT

Like many African countries, South Africa is challenged with uneven distribution and insufficient access to potable water. The issue of inadequate access to water is more pronounced in the marginalized region where most households that rely on surface water reside. Indeed, issues relating to access to water, unequal distribution and water quality perception among households remain underexplored, given that Water crises is one of the global threats in terms of societal effect and development and have been projected to be the most concerning risk ahead of climate change, extreme weather events and food crises. The study examines the level of access to water across South Africa provinces; it investigates the impact of household demographic and socioeconomic status on access to water, the relationship that exists between the household socioeconomic determinants and access to water, as well as household and socioeconomic determinants that are influencing unequal access to water. It also explores household water quality perceptions across geographical settlements and household socioeconomic determinants.

The United Nations Sustainable Development Goal 6 (SDG 6) seeks to achieve universal coverage by demanding the availability and equal access to water for everyone by 2030. This research is therefore centered on reviewed literatures upon which a conceptual framework has been drawn to provide a clear understanding of the micro and macro determinants that influence access to water and perceptions of water quality. A quantitative research methodology was used. Data was sourced from the 2018 South Africa General Household Survey. Of the 33000 dwelling units (DUs) sampled, 20905 households were included and successfully interviewed, and sampling weights were applied to represent the overall population under study. Furthermore, the GHS data were analyzed using descriptive and inferential statistics (binary logistic regression).

The descriptive finding reveals that 48% of the households in South Africa use piped water on premises, 43% use other improved water sources such as a communal tap, neighbour's tap and, borehole on site. In comparison, 9% of South African households use water from an unimproved source. 45.7% of male-headed households have piped water on the premises, while 39.2% of female-headed households have access to piped water on the premises. 50.7% of female household heads and 46.5% of male household heads use water from other improved water sources. Lastly, 10.1% of female-headed households used water from unimproved sources, compared to 7.9% of male-headed households. Household heads with a postgraduate degree and a certificate/degree with levels of 76.2% and 73.2% access, respectively. Of the households without schooling, 17.9% have access to piped water on the premises. The descriptive results also show unequal access to water levels across geographical areas, educational levels, population groups, household income, and income sources. The physical properties of water, such as safety, smell, taste and clarity, were used to examine household water quality perception. The descriptive results also indicate that some households across South Africa are not satisfied with the physical properties of their primary drinking water source; the dissatisfaction varies across household geographical location and socioeconomic status.

Using a cut-off statistic of 0.05, the chi-square test of association shows a significant positive association between the level of access to water and household socioeconomic variables such as gender, age, educational level, income, race and income source, province of residence and geographical settlement of household heads. P-value of 0.00, Household water access was influenced by gender, age, educational level, income, race and income source, province of residence and geographical settlement of household heads. Similarly, with a p-value of 0.00, gender, geographical area, age and province of residence are household determinants that influence household access to water. The study provides evidence that is beneficial to water

management services as it establishes that the quality of water and its distribution level across provinces are unequal and therefore calls for water management to make and implement water policy that considers vulnerable households.

Keywords: Accessibility, Potable Water, Water Consumption, Water Quality, Perception, Water Source, South Africa, Household, Probability.

LIST OF ACRONYMS

DWS	Department of Water and Sanitation
FAO	Food and Agricultural Organisation
GHS	General Household Survey
IPCC	Intergovernmental Panel on Climate Change
MDG	Millennium Development Goal
RSA	Republic of South Africa
SDG	Sustainable Development Goal
SPSS	Statistical Package for Social Scientists
STATS SA	Statistics South Africa
UN	United Nations
UN/DESA	United Nations/Department for Economic and Social Affairs
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNICEF	United Nations International Children's Fund
WHO	World Health Organisation

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CHAPTER ONE

The World Health Organization and United Nations International Child Education Fund (2012) define safe water as water that will not affect the body if it meets the body in any way. On the other hand, unsafe water is water that is sourced from unprotected wells and springs, rivers, ponds and water from vendors (WHO/UNICEF, 2010).

1.1 Introduction

This study examines the determinants that account for inequality in households' access to water and perceptions of the quality of water across the nine provinces of South Africa. The main objectives of the study are to examine the proportion of households with access to potable water, to determine the relationship between access to potable water and water sources in terms of socioeconomic determinants and finally, to investigate the relationship between households' perceptions of water quality in terms of socioeconomic determinants. This study makes use of the 2018 General Household Survey (GHS) data gleaned from studies conducted by Statistics South Africa. This chapter consists of the background of the study, outlines the problem statement and describes the objectives, research questions and hypotheses. It also provides the general organisation of the study.

1.2 Background to the Study

For seven consecutive years, The Global Risk Report compiled by the World Economic Forum has ranked water crises as one of the top five global threats in terms of societal effect. Over the next decade, water crises are projected to be the one of the most concerning risks, ahead of climate change, extreme weather events, food crises, and societal instability (Dos Santos et al., 2017). Indeed, the influence of water and its impact on livelihoods at both micro and macro levels, has remained a critical subject among international bodies, government officials, water management organisations and researchers, to mention but a few. According to Gomez et al. (2019)**,** water is a primary factor in life and development, and its critical function in food and sanitation makes it an indispensable resource. Gomez et al. (2019) note that this resources is significantly linked to health and development and it is impossible to evaluate one without the other, because health is a necessary prerequisite for development. Indeed, research has shown that contaminated drinking water is one of the leading causes of disease and mortality in underdeveloped countries. According to the World Health Organisation (2018), inadequate drinking water causes 502,000 diarrheal deaths per year in low- and middle-income countries, including 361,000 mortalities per year in children under the age of five.

As water is one of the universal human necessities, it is critical to recognise that water is scarce and unevenly distributed in space and time (Kudu et al., 2015). Despite the fact that water covers over 97% of the Earth's surface, just 3% is deemed safe water, with slightly more than two thirds of this frozen in glaciers and polar ice caps, and the remaining unfrozen freshwater is mostly found as groundwater, with only a small fraction above ground or in the atmosphere (kudu et al., 2015). Furthermore, while clean water as a resource is renewable, the world's supply of clean, potable water is constantly declining. As a result, the planet has been subjected to a variety of pressures since humans are the main consumers of water and demand already outstrips supply in many regions of the world, and as the global population grows, so does the consumption of water (World Bank, 2013; Gleick and Heberger, as cited in Gleick, 2014). Apart from the increase in population, other factors such as water scarcity, climate change, and urbanisation have caused the burden on water resources to be enormous (United Nations, 2010).

Regarding the pressure on water resources, Scholosser et al. (2014) have estimated that half of the world's population will be water stressed, with 80% living in developing countries. The estimated world population using improved water resources was 91 % in 2015. However, 159 million still obtain water directly from surface water supplies, whilst 58% of these populations live in Sub-Saharan Africa (United Nations and World Health Organization, 2017). Water accessibility denotes the availability of water for use by a person, or household for household purposes, such as on farms and use by domestic animals up to the normal grazing capacity of the land, regardless of whether the animals are actually owned by such an individual or household, and for land irrigation purposes (William, 2006, cited in Kudu et al., 2015). The definition of access to potable water for this study is limited to water for drinking and cooking, even though the outcome variable asked participants about their main source of drinking water. According to the preliminary definition of safe and unsafe water provided by the World Health Organization and United Nations International Child Education Fund, the study assumed that water used by households for drinking and cooking should be safe.

Globally, 3 out of every 10 persons, or 2.1 billion people, do not have access to safe drinking water (WHO/UNICEF, 2017). According to Ganio et al. (2011), the majority of the world's population lacking access to safe drinking water are in developing countries. Similarly, the United Nations Environment Programme (UNEP), has noted that 300 million Africans still lack acceptable access to safe potable water, and about 230 million people defecate in the open (Vidal, 2012, cited in Koskei et al., 2013). This suggests that individuals in developing countries are the most disadvantaged, with women and children and those in the marginalised areas being the vast majority. Despite these shortcomings, significant progress on global access to improved water coverage based on the MDG targets and achievements is noted. In 2015, approximately 91% gained access to better drinking water, exceeding the Millennium

Development Goals' (MDGs') drinking water target of halving the number of people without access to improved drinking water by three percentage points (WHO/UNICEF JMP, 2015). In 2015, "24% of the population in Sub-Saharan Africa, 65% in Latin America and the Caribbean, 94% in North America and Europe, and 57% in Central Asia and Southern Asia had access to safely managed drinking water that was located on premises, available when needed and free of contamination" (WHO/UNICEF, 2017, p.22). However, the post-MDG water discussion is focusing on addressing regional, ethnic, and socioeconomic disparity in access to drinking water that persists across regions and countries, and is even widening in some countries (Abubakar and Dano, 2018).

Furthermore, as part of the post-MDGs, the United Nations (UN) 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs), adopted in September 2015 provide a global vision to ending inequality (United Nations, 2016).

South Africa, a country with 9 provinces and a population of approximately 58 million, is affected by spatial inequality (Cole et al., 2018). This inequality, especially in terms of access to water, dates back to the history of South Africa, when clean piped water and a flush toilet were associated with white privilege and there was ethnic discrimination resulting in the majority of black South Africans only having access to dry toilets (Eales, 2010). However, with the advent of the new democratic era in 1994, this backlog in access to basic amenities **was** addressed by the Government of South Africa. According to Okonkwo (2010) and Rhodes and McKenzie (2018), since then, a commitment has been made to ensure free, basic water supply for everyone by 2013 and 2014. Free, basic water supply is defined as 25 litres per person, per day, of acceptable quality, at a minimum flow of 10 litres per minute, no more than 200m from the household, accessible for at least 350 days and uninterrupted for less than 48 hours straight per supply. About 27 million people had benefited from this by 2002.

To achieve the commitment made by the democratic government, water was enshrined as a basic human right in South Africa's 1996 Constitution, 14 years before the UN explicitly recognised the human right to water. In 1997, South Africa declared basic water and sanitation a human right under the auspices of the Water Services Act (1997), consistent with the Bill of Rights (United Nations General Assembly, 2010; Statistics South Africa, 2011; Republic of South Africa, 2012). Rhodes and McKenzie (2018**)** have argued that in a country not recognised for its abundance of water, meeting the 2013 and 2014 targets was always going to be challenging as climate change and population increase also create excessive movement and drive people to use unsafe water sources. However, notable progress is been made. Statistics have shown that households with general access to water infrastructure increased from 61.7% in 1994 to 95.5% by 2012, while 40.4% of households had access to piped water inside their households in 2002, which rose to 46.7% by 2017. The proportion of households in South Africa with access to piped or tap water in their dwellings, off-site or on-site as their main source of drinking water in South Africa had risen from 84.4% in 2012 to 88.6% in 2017 (Stats S.A., 2018). While these statistics are important and increased access is evident, the majority of citizens are displeased with the gap between the water services they receive and the service levels and quality. Tissington (2011), as cited in Rhodes and McKenzie (2018), has indicated that between 2007 and mid-2010, protests on service delivery have occurred mainly on issues relating to water supply or sanitation, over 30% of the time.

Apart from access to water, the perception of drinking water quality is of major concern to the public as well. According to Barraque (2003), cited in Doria (2010), a better understanding of the processes involved in public perception of water quality may provide a contribution to multi-stakeholder processes, help to improve consumer services and satisfaction, foster communication, promote cooperation and prevent conflict. Hu (2011) opines that perceptions of water quality are a mirror of physical water conditions. Water quality is a concern in both rural and urban locations, although the severity is greater in rural households, where significant sections of populations rely on conventional ground water sources (Sharma, 2012). The quality of water that consumers can perceive with their senses can have substantial impact on their perception regarding potable water. Users are inclined to be sceptical regarding water that seems to be discoloured or has an unpleasant taste or smell. Therefore, priority is being given to the provision of potable water that is safe and acceptable in terms of colour, taste and odour. Accordingly, the WHO acceptable standard allows for the evaluation of water quality based on human acceptance criteria, as it examines characteristics that may create unsatisfactory colour, taste, and odour. The aesthetic water quality index evaluates public perception of water quality by examining variables that may cause undesirable colour, taste, and odour. UNEP (2007) has noted that when water is highly muddy, highly coloured, or has an unpleasant taste or odour, consumers may perceive that their water is unsafe.

To abate the issues of inadequate access and uneven distribution of safe water, Dungumaro (2007) has argued that the country needs different practical approaches, such as those that inform people of different socioeconomic status. However, previous research has examined associated socioeconomic variables to access to water and perception of water quality, particularly in the South African context. In the study of the Water Poverty Index, Sullivan (2002) has noted that poor households often suffer from poor water provision, and this result shows a significant loss of time and increased effort in collecting water, especially for women. Ngum (2011) has studied household access to water and willingness to pay in South Africa, using evidence from the 2007 General Household Survey and concludes that access to water is related to willingness to pay.

Dungumaro (2007), in the study of socioeconomic differentials and availability of domestic water in South Africa using the 2002 General Household Survey (GHS), found that dwelling type, income source (salaries/wages or remittances), household size and, to a lesser extent, the gender of the head of the household, were all good predictors of access to safe water. Stats S.A. (2011) has identified significant socioeconomic variables such as home ownership, as household characteristics that are strongly associated with access to water. Rhodes and McKenzie (2018), using the 2014 South African General Household Survey, have noted that socioeconomic indicators such as province, race and geographical location are determinants of access to water. Furthermore, Wright et al. (2012) investigated public perception of drinking water safety in South Africa from 2002 to 2009 in a repeated cross-sectional study. The results suggest that perceived drinking water safety has remained relatively stable over time in South Africa and that perceived drinking water safety is primarily related to water taste, odour, and clarity rather than socioeconomic or demographic characteristics.

There has been little recent study in South Africa on identifying the socioeconomic characteristics of households that determine access to potable water, and even less on the household socioeconomic determinants that influence perception of water quality. As a result, this study focuses on identifying households that have access to improved and unimproved water, socioeconomic determinants that influence disparities in access to potable water, and socioeconomic determinants that influence perception of water quality. Therefore, to achieve the aforementioned objectives and close the gap, this study has employed data from the 2018 General Household Survey, with the aim of contributing to prior work in this subject area.

1.3 The Problem Statement

Generally, significant and consistent measures have been taken by researchers and the South Africa Government to reduce the discrepancies in access to water. However, access to safe water continues to be a challenge. According to studies, the problem and discrepancies in access to water are most visible across ethnic groups, provinces, and gender lines. Nevertheless, researchers have linked the determinants of access to potable water, such as income, family size, gender, the educational level of the household head and the quality and availability of potable water supply. It is still unclear what is causing this lack of access to potable water, particularly in South Africa. A study conducted by Dungumaro (2007), where data from the 2002 General Household Survey was analysed to investigate the quality and accessibility of households' potable water supply, reached a ground-breaking achievement in terms of significance and success. Although his analysis methods are still valid, this research work was carried out when the population of South Africa was approximately 44.8 million. In addition, several changes have been observed in how household variables are grouped. With the rate at which the population of South Africa has increased over time and given the improved reliability and comprehensiveness of 2018 GHS data, it is imperative to re-examine some household determinants and investigate whether they influence households' access to water.

Regarding water quality, the Department of Water and Sanitation (DWS) notes that the government is now aware of the growing public concern about water quality problems. The recent DWS report shows that after auditing 1200 water supplies across the nation, more than half (60%) of systems failed to meet microbiological norms, while 77% failed to meet chemical treatment requirements. Given the above statistics, this study tends to understand household perceptions of water quality. Furthermore, related research segregates water quality from access to potable water and sanitation, limiting their association with socioeconomic variables. More research on water availability that takes into account South African households and perceptions of drinking water quality in terms of taste, odour, and colour, is also required.

This study aims to bridge the gap by examining the determinants of household access to potable water and perceptions of water quality in South Africa's nine provinces, using data from the 2018 General Household Survey. The study will also further understand the relationship and variation in household access to water and perceptions of water quality.

1.4 Significance of the Study

This study will provide information on the different ways in which households' access to water and how they perceive the quality of their potable water concerning the physical qualities of water. This research is significant because it examines the determinants that influence inequalities in household access to potable water and perception of water quality. Using the joint monitoring programmes' services approach, the study will assess access to water beyond 'improved' or 'unimproved' classification. The implications of a lack of household access to potable water will be addressed and recommendations made which can sharpen water supply policies, with an emphasis on disadvantaged households, marginalised communities and provinces as a way of reducing inequalities and increasing access to potable water sources.

1.5 Objectives of the Study

The following are the specific objectives of this study:

- To determine the proportion of households with access to improved water sources in South Africa using the 2018 General Household Survey.
- To determine the regional variations in access to water (i.e. how it varies across provinces, as well as rural-urban variations).
- To assess the socioeconomic determinants of household access to water.
- To examine consumers' perceptions of potable water quality in South Africa and how socio-demographic determinants affect households' perceptions of drinking water quality.

- To determine the relationship between water sources and households' perceptions of water quality.

1.6 Research Questions

This study addresses a general question and several specific questions.

1.6.1 General research questions

What relationships exist between access to water and socioeconomic variables such as distance to water source, age, gender, population group, education level, monthly income, and income source of the household head?

Is there any relationship between perceptions of water quality and socio-demographic variables?

1.6.2 Specific research questions.

- How does the gender of the household head affect access to a potable water source?
- What is the relationship between the source of income of the household head and access to potable water within a household?
- Does the monthly income of a household head influence access to potable water?
- Is there a relationship between the level of education of a household head and access to potable water?
- Does the population group of a household head affect access to potable water?
- Is there an association between distance to water and the gender of the household head?
- Does the province of residence and geographical settlement area influence households' perception of water quality?
- Does the age of the household head influence their perception of water quality?
- Is there an association between a household head's monthly income and their perception of water quality?

1.7 Hypotheses

The following hypotheses are to be tested in this study:

- Households headed by females are less likely to have access to improved water sources.
- There is a relationship between households' sources of income and access to improved water sources including household income, and perception of water quality.
- There is a relationship between the level of education of a household head and access to an improved water source.
- Access to potable water sources is associated with the population group of the household head.
- The province of residence and geographical settlement area influences a household's perception of water quality.
- There is a relationship between the age of a household head and their perceptions of water quality.

1.8 Professional Background to the Study

According to the reviewed literature, the primary focus has been on access to water and sanitation; however, to the best of the researcher's knowledge, no research on access to water and perception of water quality has been conducted simultaneously in the South African context, using a 2018 general household survey. This study aims to fill the gap mentioned above and contribute to the existing knowledge by investigating how household socioeconomic characteristics hinder or enable households in terms of accessing water, and the determinants that influence household perception of water quality. It is anticipated that the findings of this study will be of great assistance in water management policy, since investigating the socioeconomic determinants that influence the behaviour of households' access and choice of potable water is a starting point toward developing and implementing more appropriate water policies and initiatives, aimed at reducing disproportions in access to improved drinking water (WHO/UNICEF, 2010).

1.9 Delimitation

This study focuses on the determinants influencing access to water and perception of water quality, using the 2018 General Household Survey from the Statistics South Africa (Stats S.A.) as a pointer in understanding factors that hinder households from accessing potable water in South Africa and the inequality that still exists. It is worth noting this study has made mention of some variables such as urbanisation, climate change and population growth in the literature review that do not appear in the research questions because the data used in the study does not address these variables, hence they were used as a point of reference. This study also does not address inequality along gender lines but across geographical setting and provinces and, finally, perception of water quality mainly relates to South African provinces and not to municipalities.

1.10 Definition of Related Terms

Accessibility: Access to water refers to having a constant supply of water close to the point of demand and within every person reach: at home, school, work, and public sites. It is the distance between the water supply and the consumption place not more than 0.2km or 200m (Dinka, 2018, p.168). According to Aiga and Umenai (2003, p.2156), "The World Bank defines accessibility in terms of residential area: In urban areas, a safe water source may be a public fountain or point of supply located no more than 200 meters away. In rural areas, access means that household members do not have to spend a disproportionate part of the day catching water."

Potable Water: The term potable water as defined by the Oxford Dictionary as water that is safe for drinking. According to the WHO report, potable water is water that "does not represent any significant risk to health over a lifetime of consumption, including different sensitivities that may occur between life stages" (World Health Organization, 2004 p.1).

Perception: In this study, perception is defined as the way in which water is seen and interpreted by our sensory organs, such as eyes, nose and tongue.

Water Consumption: It is the average amount of water used per household, per day.

Water quality: This term defines the level at which the water is clean, clear and free of odours, and the level at which it is suitable for drinking, according to Nancy (2009). It defines the quality of water as a chemical, and the physical and biological state of water for the specific purpose for which it is intended (drinking, swimming, fishing or agriculture).

Water sources: In this context, the term water sources refers to the water supply facility or the location from which water can be obtained. However, Statistics South Africa (2011) has subdivided this water into two categories: safe and unsafe. It defines water from a river, dam, well or stream as being unsafe water, while piped water into premises and water from boreholes (private or communal) is classified as safe water.

1.11 Structure of Thesis

The thesis is organised into six chapters and they are as follows:

Chapter One gives a clear introduction of the thesis, it provides the background to the study, the research problem, the study's justification, research questions and hypotheses, as well as the objectives of the study.

Chapter Two provides a review of literature on access to water and perceptions of water quality in a comprehensive manner, by exploring the different dimensions that access to water and perceptions of water quality are related to. It gives a brief review of up-to-date history and statistics with regard to water.

Chapter Three presents the statistical methods, procedures and data used for the research. The key variables for the study are described and it mentions how variables in the research will be operationalised.

Chapter Four presents the data analysis results based on the research questions and hypotheses.

Chapter Five presents the discussion of findings and relates the findings to empirical research.

Chapter Six presents an overview of the findings, as well as suggestions and recommendations related to the research topic. The conclusion of the thesis is also provided in this chapter.

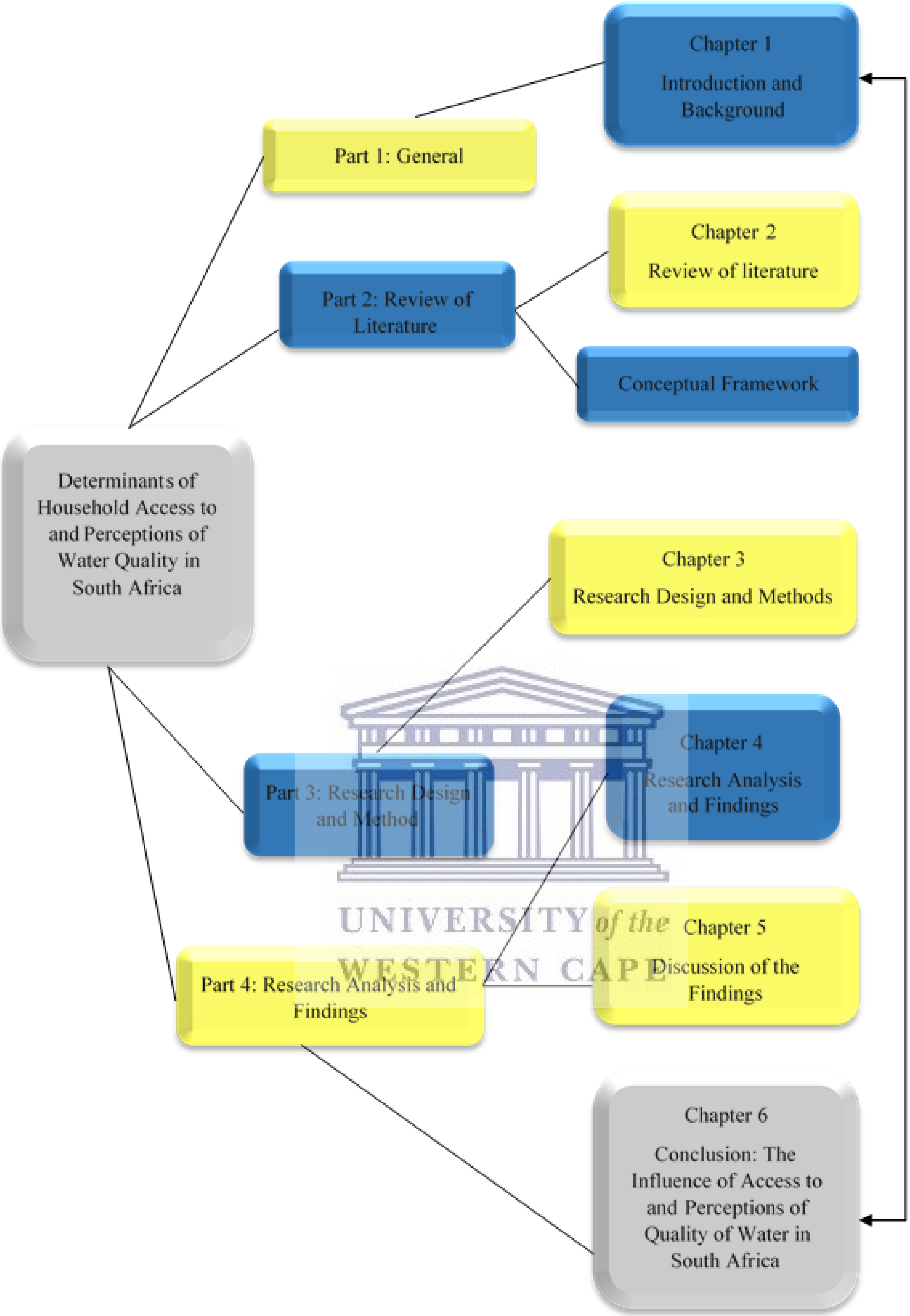


Figure 1.1: Thesis Structure Showing Chronological Links between Chapters

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter offers an exploratory discussion of the various relevant concepts used in the research. It conceptualises water access and perception of water quality and further explains the relationship between access to water and water quality. It also investigates the potential of water security. The debates over water, human rights, and the Sustainable Development Goals (SDGs) are also highlighted. The chapter begins with a review of water availability and scarcity, moves on to water security, and then discusses household water-sourcing behaviour and the different determinants that influence households' access to and perceptions of water quality.

2.2 Water Availability and Scarcity

Water is a crucial determinant in all facets of human life and penetrates all crucial areas of life, so it should be available anytime and wherever it is needed. Water is considered a natural resource in general, although not all water on the planet is suitable for human use. For instance, about 96% of the water on the planet is saline and in the ocean, with just 3% being freshwater (Balasubramanian, 2015). Agriculture, recreational, environmental, and household activities all need water; however, water availability has become a global concern because freshwater is in high demand. Water availability in the study is discussed with reference to blue water. Sood and Prathapar (2014) refer to blue water as water collected from any surface water supply facilities, such as dams, rivers, reservoirs, or water which circulates beyond the root zone to generate groundwater. Blue water supply varies from year to year, and not all blue water can be utilised due to economic, technological, and environmental constraints (Hoekstra et al., 2012). According to FAO (2017), water withdrawal for activities that include agriculture, industrial and domestic use is 1.7 times higher than the water required by mere population numbers. Countries are starting to reach the point where services can no longer cope with the demand. When water demand is higher than supply, the issues of water scarcity occur.

Water scarcity is used to characterise the relationship between the demand for water and supply. The United Nations (2018) defines water scarcity as the physical lack of water or a scarcity of access to water caused by the malfunctioning of relevant institutions. This implies that water scarcity is driven by major factors, broadly categorised as physical water scarcity and economic water scarcity. Vanham et al. (2018) refers to physical water scarcity as a situation in which there is an insufficient amount of water to satisfy a region's demand. Countries in the arid regions are susceptible to physical scarcity. In another vein, Falkenmark (2007) states that excessive demand, population growth, climate change and water pollution could lead to severe physical scarcity. Economic water scarcity stems from a lack of investment in water supply infrastructures, a lack of political will to accept that there is an increasing need for water, and a lack of human ability to meet the demand, resulting in a lack of access to the water supply (Water Aid, 2013). Economic scarcity implies that people will find it challenging to get adequate water for household use and anywhere else water is needed.

South Africa is one of the world's most water-scarce nations. Like the rest of the world, water scarcity is becoming a serious concern because humans and industries need water in sufficient quantity to survive and thrive. However, water problems in South Africa go beyond water scarcity, as there are other issues, such as a decrease in the quality of water, dysfunctional municipal water supply infrastructures that have resulted in the ongoing water crisis being publicised nation-wide by the media, unequal distribution, and the illegal use of water, among others. These do not only influence water availability but also have a negative effect on human health. In terms of statistics on water availability and scarcity, the Department of Water and Forestry (DWAF) (2004) noted that the yearly demand for freshwater in SA as of the year 2000 amounted to 12 871mm^3, which is less than the available freshwater of 13 227mm^3, yielded in the same year. Furthermore, in 2000, 5 of the 19 water management areas (WMAs) faced water shortages. The projection made by the DWAF indicates that the problem of less water supply and high demand will become more prevalent (DWAF, 2004; DWAF, 2009; Muller et al, 2009). This implies that proper attention is needed in the water sector to avert the ongoing scarcity and the projected water scarcity that may occur, given that water demand and consumption has been projected to surpass availability and supply – hence the call for water security and sustainability.

2.3 Water Security

Water security is an important goal in developing countries, particularly in South Africa. However, because of the essential nature of the concept and the fact that it is applicable at all levels of society, including households, communities, state, regional, and international levels, it has become a subject of much discourse among scholars, policymakers, and international bodies. Accordingly, Lal et al. (2013) noted that water and food security are global agendas requiring innovation. Cook and Bakker (2012) clearly stated that the framing of the concept is not consistent, as it varies depending on context and disciplinary views on water use. The United Nations (2019) defines water security as a country's ability to provide safe access to sufficient and high-quality water for human well-being, the prevention of water-borne diseases and pollution, social stability, socioeconomic growth, and ecosystem preservation. The UN recognises that water is a basic human right, based on the declaration made in 2010 by the UN General Assembly. This law is also enshrined within the South African constitution (DWS, 2016). The UN has placed a strong focus on this right to meet basic human needs, such as supplying consumers with water that is both available and inexpensive. The concept of water security has also been used by the UN to emphasise the importance of ensuring access to adequate and clean water. Similarly, the Global Water Partnership (GWP) (2000) describes water security as a situation in which every individual has sufficient water at a low cost to allow them to live a good, healthy, and efficient life, while also protecting the environment. As in the previous definition, this one covers three main aspects that are critical to this study: affordability, accessibility, and quality.

Water security is under serious threat. As previously mentioned, over 1.1 billion people worldwide lack access to a clean water source, with 51% of the population being in Sub-Saharan Africa without such access (UNDP, 2006). The poorest countries in Asia and Africa are the most disadvantaged, with millions of people without access to safe, centrally provided water, causing the majority to rely on polluted surface or groundwater. According to Vörösmarty et al. (2010), amid the need for better access to safe drinking water, almost 80% of the world's population remained exposed to high levels of water insecurity in 2010. This is also true in Africa, where many countries, especially in rural areas, still lack adequate water supply (WHO/UNICEF JMP, 2015; Heijnen et al., 2014). Water security issues are a concern for all countries, including South Africa. In 2016, the country was hit by one of the worst droughts in decades. As a result, many towns and cities with severely deteriorated water storage infrastructure were affected, forcing the country to seek alternate water supplies.

Furthermore, South Africa faces water insecurity due to various factors, including poverty, underdevelopment, governmental inefficiency, and inadequate service supply to the poor. Rapid population growth and increased demands from an increasingly urbanised population have put additional strain on the country's water systems. Water insecurity has socioeconomic consequences. For instance, ActionAid (2016) and the Department of Water and Sanitation (DWS) (2017) noted that insufficient water leads to the prevalence of service delivery protests around the nation. In most cases, the people's grievances are mainly over a lack of or limited access to water, and these demonstrations are led by individuals who have never been served or whose services are no longer functional (DWS, 2017). As a result, water shortages require immediate attention to avoid potential water crises and riots.

2.4 The Concept of Access to Safe Potable Water

Water is a vital commodity, and it is directly or indirectly related to every aspect of day-to-day human activity. As a prerequisite, water must be sufficient, clean, and safe for various users. According to Bos et al. (2016), potable water is safe for drinking, food preparation, and personal hygiene and can be quickly supplied to consumers. The Monitoring Organization consumer, under the guidance of the Joint Monitoring Organization led by the World Health Organisation, describes safe potable water as water collected from improved sources, including household pipes, public/communal standpipes, boreholes, protected wells, protected springs, and rainwater collection. On investigating the definition of safe drinking water, Dinka (2018) explains that the term ‘safe drinking water’ is relative and debatable, as protection depends on the standards and guidelines of the organisation, country, or person. For example, the World Health Organization (WHO) standard of water safety differs from the USA, Canada, the European Commission, Russia, South Africa, etc. However, academics, policymakers, and others have continued to make efforts to deepen their understanding of what ‘access to safe potable water’ should constitute.

Furthermore, the Joint Monitoring Program (JMP) led by the World Health Organization describes access to safe potable water as the availability of at least 20 litres per individual, per day. At the basic level, clean water in sufficient quantities must be available to everyone, irrespective of age, gender, and geographical location. This has caused international bodies such as the United Nations, to unanimously recognise access to clean drinking water as an international agenda and a priority; this is evident in the initiatives and visions of the MDGs and SDGs. In 1976, the United Nations Conference on Human Settlements initiated the International Drinking Water Supply And Sanitation Decade (1981-1990), intending to provide recommendations for the swift response on initiatives to increase the quality and quantity of water sources for urban and rural areas by 1990. This led to expanding water supply coverage for vulnerable people who did not have the requisite facilities. Over this decade, a wide variety of low-cost water solutions was implemented (Najlis and Edwards, 1991). From the year 1990 to 2015, the MDGs of the UN created another initiative, which was to halve the population without safe drinking water. In 2015, the MDGs came to an end with substantial progress in accessing improved water having been made. The global target for clean water was reached, with 91% of the world's inhabitants gaining access to improved potable water compared to 76% in 1990 (Mulenga et al., 2017).

In addition, the WHO and UNICEF's 2017 Progress Report on Drinking Water, Sanitation, and Hygiene showed that in 2015, 5.2 billion people (71% of the world population), made use of a safely managed drinking water facility that was located within the premises, available and free from pollution. The report also revealed that one out of three people using a safely managed potable water facility (approximately 1.9 billion of the global population), lived in a rural area. Moreover, only five regions in developing countries reached the target, with the Caucasus and Central Asia, Northern Africa, Oceania, and Sub-Saharan Africa (SSA) failing to meet the MDGs' target. (WHO/UNICEF JMP, 2015). Although the report has shown substantial progress regarding access to improved water supply, it also shows that large disparities still exist across nations, within countries and, between genders, etc. (Osei et al., 2015; UNICEF, 2016). Therefore, to address the disproportions in access to water, much work still has to be done to ensure that Sustainable Development Goal 6 (SDG 6) is an extension of MDGs that focus on achieving worldwide and equitable access to safe and affordable potable water for all by 2030. (WHO/UNICEF JMP, 2015; UN 2017).

The SDG 6 target is an important initiative that will help keep track of the inequalities in access to improved water. The focus of the goal is mainly on bridging the gap in access to basic amenities. Apart from SDG 6, which is aimed at achieving universal and equal access to improved potable water, the SDG 10 is also aimed at reducing the inequality between and within countries, and the agenda further commits its member states to 'leave no one behind'. Furthermore, the SDG indicators used in measuring access to water should be separated by income, age, ethnicity, migratory status, disability, and geographical location where necessary (UN, 2015). Achieving universal access to water and eliminating inequality is a critical challenge that the world still faces in recent times and this has been the subject of several studies and much discussion (United Nations, 2017). Even though water has been recognised as a human right by international bodies and countries, the issue of inadequate and inequality of access to safe potable water persists, hence the need for intervention (WHO, 2012). Furthermore, it is important to note that this issue is more alarming in developing countries, especially Sub-Saharan Africa (Dos Santos et al. 2017). This is an indication that a large number of people in developing nations still depend on unsafe water sources for their daily activities.

As indicated above, Sub-Saharan Africa (SSA) is one of the regions in the world with low levels of coverage in terms of water. While access to water in a developed or high-income setting is universal, it is a basic need that does not exist in the Sub-Saharan region. The region is home to 319 million people (about half of the world's population, 663 million), who are using an unimproved source of drinking water resides (WHO/UNICEF JMP, 2015, p.7). The statistics above are evidence that the region is lagging in access to water. Furthermore, the trend in access to water in Sub-Saharan Africa shows that water supply was 40% in 1990, increased to 60% in 2008, and increased to 68% in 2015 (Uinted Nation, 2017).

Nonetheless, the entire SSA region did not meet the Millennium Development Goals of splitting the share of the population with access to safe water, but progression in access to water was seen with about 42% of its inhabitants gaining access to improved potable water (WHO/UNICEF Joint Water Supply and Sanitation Monitoring Programme, 2015). Furthermore, it was projected that in 2025, about 25 countries in SSA will be facing water shortages, which implies that 230 million people will be living in water-scarce areas, and another 480 million of the population will be living in a water-stressed area (Sun et al., 2021). However, certain factors have been identified as influencing this, and they include urbanisation, population growth, and climate change. Interestingly, most countries, especially those in Southern Africa, such as Botswana, Lesotho, Namibia, and South Africa, are already experiencing this insufficiency and inequality in access.

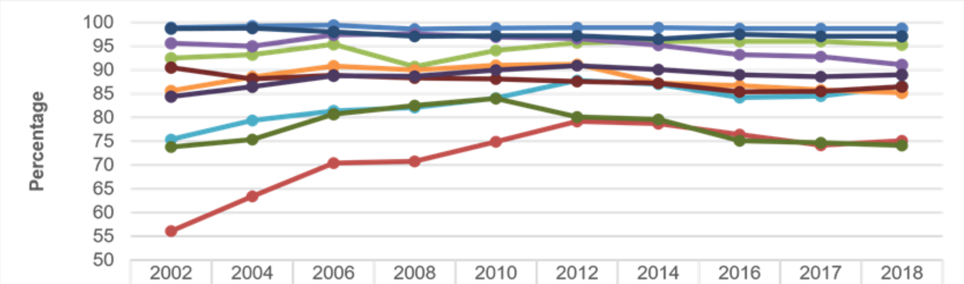
South Africa, the context of this study, is rich in various natural resources such as gold, diamonds, and platinum. However, the country struggles with freshwater availability, despite it being a critical resource for human survival and national development.

South Africa has limited water resources that are unevenly distributed across the country. Moreover, it is considered the 30th driest country globally, and this rating is dictated by the fact that its annual rainfall is about 500mm a year (DWA, 2013). Despite the apparent dearth of water in South Africa, water is directly responsible for a significant amount of the country's gross domestic product (GDP). For instance, in South Africa, 52% of water is mainly used for agriculture and irrigation, 4% in forestry, industry uses 4%, domestic use is 10% and 20% is protected for the environment's survival. As a water-scarce country, South Africa has the Department of Water and Sanitation (DWA) to manage its water resources.

Access to improved water is very relevant to people's livelihoods. Therefore, it was included in the Sustainable Development Goals, specifically SDG 6, reflecting the need to ensure that everyone has access to safe potable and sustainable water management. This goal is in keeping with the South African water and sanitation policy, which aims to ensure universal access to water and the right to clean and safe water. The National Water and Sanitation Master Plan also emphasise that "it is a legal obligation in the national water and sanitation policy papers, the National Water Act, and the Water Services Act, to offer universal and equitable access to clean water and sanitation services" (DWS 2018, p. 17). The National Development Plan 2030 also recognises that efficient and sustainable management of water supply and sanitation services is key to community health, development, unity and continued economic activity (NPC, 2012). In South Africa, public access to resources and services is nevertheless entwined with equity concerns. Water and sanitation access is inequitable, reflecting the country's high levels of economic inequality rooted in the country's apartheid heritage (DWS 2016). Understanding the past and current events, the proportion of households using a particular water source, exploring the determinants of access to water services, especially at the household level, and household perceptions of water quality are all critical to closing the gaps in providing access to water.

As South Africa achieved the Millennium Development Goal of reducing the population with inadequate access to water in 2005, data from Stats S.A. shows that the number and percentage of homes with piped water had increased, with 13.2 million households having piped water in 2014, compared to 9.3 million in 2005. However, over this decade, households indicating they were paying for water had significantly decreased, falling from 61.9% in 2005 to about 43.7% in 2014 (Stats S.A., 2015). In 2014, 90% of households had piped water, but just 78.5 % in the Eastern Cape had access to piped water. About 27% were recorded as getting their water from on-site sources, while 14% used community taps and 2.7 % used their neighbours' taps. Although family access to water is improving, in 2014, 4.2% of households were still collecting water from rivers, streams, stagnant water pools and dams, wells, and springs (Stats S.A., 2015). It is against these backlogs that this study is being conducted.

Furthermore, Figure 2.1 below shows the trend of access to water across province from 2002 to 2018. Tap water inside their dwellings, off-site or on-site that are not more than 200m away from dwellings were classified as improved water sources. The tap water inside their dwellings, off-site or on-site results shows that access to this source is mostly common among households in the Western Cape (98,7%), Gauteng (97,1%), and Northern Cape (95,3%) and access within these province has been relatively stable from 2002 to 2018. These sources are, however, least common in the Eastern Cape (75, 1%) and Limpopo (74, 1%). As seen in the Figure 2.1 below, since 2002, the percentage of households in the Eastern Cape with access to water has increased by 19.0% and those in KwaZulu-Natal by 11.2%. Nationally, the percentage of households with access to tap water in their dwellings, off-site or on-site increased by 4.6% during the same period. Even with these notable progresses, access to water actually dropped in five provinces between 2002 and 2018. The highest decrease was observed in the Free State (-4.5%), followed by Mpumalanga (-4.0%) and Gauteng (-4.0%). (-1.6 %). The decline, however, contradicts the fact that many more households have had access to water in 2018 than 17 years earlier. As a result, the current study findings would compare to the same general household survey (GHS) 2018 dataset to evaluate whether there are any discrepancies or similarities.



	2002	2004	2006	2008	2010	2012	2014	2016	2017	2018
WC	98,9	99,2	99,4	98,6	98,8	98,9	98,9	98,7	98,7	98,7
EC	56,1	63,4	70,4	70,8	74,9	79,2	78,7	76,4	74,2	75,1
NC	92,5	93,2	95,4	90,7	94,1	95,7	96,0	96,0	96,0	95,3
FS	95,6	95,0	97,4	97,6	96,9	96,6	95,2	93,2	92,8	91,1
KZN	75,4	79,4	81,4	82,1	84,1	87,8	87,0	84,2	84,5	86,6
NW	85,6	88,5	90,8	90,0	91,0	91,2	87,2	86,7	85,8	85,2
GP	98,7	98,8	98,0	97,1	97,2	97,2	96,5	97,5	97,1	97,1
MP	90,5	88,1	88,9	88,3	88,1	87,6	87,2	85,4	85,5	86,5
LP	73,8	75,4	80,7	82,5	84,0	80,1	79,6	75,1	74,7	74,1
SA	84,4	86,5	88,8	88,7	90,0	90,9	90,1	89,0	88,6	89,0

Figure 2.1: Percentage of households with access to pipe or tap water in their dwellings, off-site or on-site by province, 2002–2018. Source: GHS, 2019 Report.pp.37-41/

2.5 Sources of Water

Water sources refer to the points at which water can be collected; this point of the collection has two classifications: improved and unimproved collection points. Accordingly, the WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP) (2014) identifies three primary water sources: piped water on-premises, improved sources, and unimproved sources. In 2017, the JMP further revised the definition of improved and unimproved water sources. The JMP assert that improved water sources are those sources that have the potential of delivering safe water by the nature of their design and should be able to meet the following three criteria: accessible within the premises, available when needed and should be free from pollution. Therefore, for a household to enjoy the benefits of improved water, it must have indoor access to safe and reliable water sources. While this is nearly factual in a developed country, such access is far from true in developing countries, especially in rural areas.

Table 2.1: Improved and unimproved drinking water sources as defined by the JMP

Improved drinking water source	Unimproved drinking water source
Piped water into dwelling, yard, or plot	Unprotected dug well
Communal/public standpipe	Unprotected spring
Borehole	Cart with small tank or drum
Protected dug well and protected spring	Tanker truck
Packaged or delivered water	Surface water, e.g., river, dam, lake, pond, stream, canal, irrigation channel
Rainwater collection	

Source: WHO/UNICEF (2017).

According to the African Ministers' Council on Water (AMCOW) (2011), the acceptable basic level of safe potable water as indicated by the South Africa government is the supply of piped water that is not more than 200m away from the dwelling. Majuru (2012) noted that the actual distance to the point of water supply is about 600m and more for the rural areas in South Africa. In 2013, Stats S.A. (2014) reported that the total number of households who had access to water from their municipalities was 89.5%. In that same year, it estimated 45.3% of households had access to piped water in their dwellings in 2013, 26.8% accessed water on-site, while 15.2% relied on communal taps and 2.6% relied on neighbours' taps; 4.2% of households still had to fetch water from rivers, streams, stagnant water pools and dams, wells and springs (Stats S.A., 2014). Furthermore, the statistics in 2015 show that over the years there has been fluctuation in the percentage of household from the different water sources. For instance, in 2015, 45.8% of households had access to piped water in their dwellings, 27 % accessed water on-site while 14% relied on communal taps, 2.7% depend on neighbours' taps and 4.4% of households still had to fetch water from rivers, streams, stagnant water pools, dams, wells and springs (Stats S.A., 2016). Households without access to a reliable water supply face challenges relating to deprivation of involvement in essential and meaningful occupations (Majuru, 2015). Below are some of the water supply sources which provide households access to water in South Africa.

2.5.1 Dams and rivers

South Africa has more than 500 water dams which constitute its storage reservoirs to maintain water supplies in times of water stress. The main purpose of dams in South Africa is for irrigation and urban water supply. Dams are classified as unimproved water sources even though they serve as relief in times of water stress, because they have a high level of pollution that comes from the mining industry and agricultural activities (DWA, 2011). Similarly, rivers are also considered unimproved water sources because industrial, agricultural and domestic waste pollutes the water. A report from the DWA shows that in the next year 30 years, the demand for freshwater will increase to 52 per cent (DWA, 2014).

2.5.2 Boreholes

Boreholes are classified as improved water sources. They are used extensively in South Africa, especially in rural areas and more areas that are arid. Boreholes as water resources supply about 13% of the total volume of water consumed, although more groundwater is use for irrigation. South Africa uses between 2000 and 4000 million m3/acre of the 10343.4 million m3/acre of groundwater availability, and it decreases during drought conditions (DWA, 2010). Even though boreholes are considered to be improved water sources, the quality of water produced is questionable, and this is so because, according to the DWA (2010), the state of the water supply infrastructure may be bad.

2.5.3 Spring water and protected wells

Springs are visible outlets of natural underground water and are classified as an improved water source. Wells consist of subsurface water that does not appear above the natural surface of the ground. Unlike spring water, well water can only be accessed by digging a well, and this is classified as an improved water source – if it is protected.

2.5.4 Rainwater

Rainwater can be collected and stored for household consumption. The amount of rainwater that is collected is dependent on the storage facility that can provide the household with sustainable supply during a period of little or no rainfall. Given that South Africa is an area with low rainfall, this is unevenly distributed across provinces. Rainwater is one water source which is highly underutilised, particularly in areas with high rainfall. It is therefore recommended that governments and organisations promote the use of rainwater, while also providing safety procedures that can be considered when collecting safe water in order to avoid gathering polluted water.

2.6 Household Water Sourcing Behaviour

Globally, households source water differently, and their demand for water varies. According to Ashaolu and Onundi (2014), this variation is seen across different geographical settings (urban and rural). As stated previously, household water is considered water used for many purposes, such as domestic, industrial, and agricultural purposes, in order to meet individual needs and development. Every individual belongs to a unit called a household; therefore, understanding how water is sourced and used within this household unit is crucial for human and social development. Ashaolu and Onundi (2014) further argue that there is a relationship between where water is sourced, allocated and used within the household. This implies that if a household sources its water from an improved source that is piped water, borehole, or 200m away from the residence, it is more likely that the water will be used for drinking and cooking. Therefore, understanding how water is sourced within the household can provide an insight into the household determinants that are responsible for inadequate and uneven access to water.

The functions of water are numerous, and within the household, members are tasked with sourcing water which is used for different purposes. The household member with the responsibility of collecting water may choose specific water source because the water from that point is safe and clean and can be used for drinking, cooking, and washing. Sourcing water is a problem in many developing countries. This problem affects people living in both urban and rural areas; however, in an urban area, those living in the informal settlements are mostly affected and this is because of limited incomes and, furthermore, most of these areas are not prioritised by government when allocating resources and providing services. Apart from these factors, Ashaolu and Onundi (2014) listed some challenges faced when sourcing water: inadequate water points, faulty taps, and few boreholes.

Furthermore, studies have shown that household water use and demand can be attributed to various determinants, such as time taken to collect water, climate conditions, educational campaigns, socioeconomic status, and other variables, such as income, gender, number of women in a household, price of water, household members, the cultural origin, the age of the household head and number of rooms per household. These are factors that influence household water sourcing behaviour (Ayanshola et al., 2010; Troy et al., 2005; Mu et al., 1990). Nketiah-Amponsah, et al. (2009) identified socioeconomic determinants of the household source of drinking water in Ghana. The study used data from a survey conducted in three districts, namely, Lawra, Dangme West and Ejisu-Juaben. The study interviewed 531 households using a stratified random sampling method. The results show that income, residence (rural or urban), education level of the household head, and the distance between the residence and water source are some of the determinants that influence household water sourcing behaviour. Coster and Otufale (2014) carried out a more recent study in Ogun State, Nigeria. The study estimated both household water use and willingness to pay for improved water services. The major sources of water for households in the study include private connection, public piped water, wells, and rivers. Data from 216 randomly selected households was used, and the study utilised the Generalised Linear Model (GLM) and binary logistic regression analysis to predict household water demand and determinants of Willingness to Pay (WTP), respectively. The results from the models showed that water connection payment, household size, marital status, water availability, and quality of water were positively and statistically significant in terms of water use.

2.7 Water, Human Rights and the Sustainable Development Goals (SDGs)

The Sustainable Development Goals (SDGs) were established for the period 2016-2030. Prior to this, there were also the Millennium Development Goals (MDGs), which were put in place in 2002 to eradicate poverty, prevent the spread of HIV/AIDS, and promote gender equality, health, education, and environmental sustainability (United Nations, 2017). The MDG target 7c also aimed to reduce the proportion of the population lacking access to water and basic sanitation to half (WHO, 2018). The Joint Monitoring Programme (JMP), which controls reporting progress on the MDGs' 7c target, also measures access to improved and unimproved water source facilities as proxy indicators for safe water access (WHO/UNICEF, 2010). Similarly, as an indicator for safe drinking water, the United Nations General Assembly recognised water as a human right in 2002 (United Nations, 2010). The adoption of these resolutions by the UN Member States means that they have acknowledged their responsibilities as duty-bearers for the realisation of the rights and can thus be held responsible for progress toward their full realisation.

Furthermore, according to JMP statistics, the targets set for access to safe drinking water were met in 2010, five years ahead of schedule, and progress made with the MDGs was remarkable (WHO/UNICEF, 2012). However, studies have shown setbacks in the MDGs' water goals and success rate. According to Weststrate et al. (2019), access to a better water supply fails to account for water quality because better water sources may be contaminated, and data inconsistency further complicates attempts to evaluate the effects of MDG 7c on marginalised groups. Price et al. (2019) also argued that the MDGs' focus was mainly on the physical access to improved water sources, without considering the safety, affordability and reliability of the water source. In 2015, the Sustainable Development Goals (SDGs) substituted the MDGs. The SDG 6 seeks to achieve universal coverage by demanding the availability and sustainable management of water and sanitation for everyone by 2030 (WHO/UNICEF, 2017). According to Weststrate et al. (2019), the SDG 6 priorities address the MDG setbacks by providing water source location (accessibility), affordability, water supply consistency, and water quality as criteria. As a result, the WHO contends that to achieve universal, equal, and sustainable access for everyone, drinking water that is safely managed should be used as an indicator for safe access to potable water (World Health Organization, 2017). The WHO and UNICEF (2017) described safely managed drinking water sources as potable water from an improved source, on the premises, that is available and accessible when needed and free of pollution.

In 2017, due to critique on the spectrum with which access to water is measured, the JMP introduced a new water spectrum to try and address some of the limitations associated with the improved-unimproved water access categories. In the reorganised JMP ladder, the major components of 'safely managed' water are accessibility, availability, and quality (WHO/UNICEF, 2017). Even though the previous and current steps regarding access to water still require access to an improved water source, Price et al., (2019) noted that the JMP current water ladder has a more in-depth understanding of access to water and is an important development when moving from the MDGs' safe access to water to the SDGs' universal access to water for all. In addition, the Water Development report indicates that water and sustainable development have a strong connection that is far beyond its social, economic, and environmental dimensions (UNESCO, 2015).

Furthermore, the SDGs' definition also took into consideration the UN's fundamental basic right to water. The United Nations have implemented this human right to water as a crucial step toward improving the global standard of living. Despite the UN-MDGs' and UN-SDGs' efforts to provide universal access to water for all, there are still noticeable gaps in access to clean water throughout the world, particularly in developing countries such as South Africa. According to the Third World Academic Science (TWAS), this disparity can be seen within and across nations, and it has a greater effect on the poor, women, and children (TWAS, 2002). According to Bos et al. (2016), the inequity of access to water and sanitation is generally unreasonable, and law prohibits it.

2.8 Determinants of Access to Potable Water

One of the most significant prerequisites for long-term sustainability is access to safe drinking water. Access to safe drinking water helps countries progress by reducing the occurrence of waterborne diseases, including diarrhoea. As a result, it is vital to understand the variables that impact a household's choice of water supply. Sustainable water management for drinking and other domestic purposes requires knowledge of the determinants influencing household water demand. Many studies on household water behaviour have focused on identifying the factors that influence how people choose their water sources. There are two kinds of determinants: micro and macro determinants. Macro and micro factors are relevant in this study because of their effect on water access. Macro factors include economic, political, and environmental factors. Individuals and families, as well as the entire population, are affected. On the other hand, micro determinants deal with the economic position of the family, such as education and income. These must be identified to identify water supply choices and, in turn, to address South Africa's unequal water access problems (He, 1992).

2.8.1 Macro determinants of water access

2.8.1.1 Urbanisation

One question that appears fundamental to examining households' access to water is the impact of urban change on the demand for residential water consumption. Kabangure et al. (2016) define urbanisation as the increase in the proportion of people living in urban areas resulting from people moving from rural areas to urban areas. Countries around the world are faced with the challenges of urban growth. The United Nations has predicted that in the year 2050, 2.5 billion people of the world's population would be living in urban areas, and this will be as a result of natural increase and migration and, most of all, this urban growth will take place in developing countries (United Nations, 2011; UNDESA 2015;). In Sub-Saharan Africa (SSA), the urban population growth is expected to triple. The projection for the region estimates that urbanisation will grow from 346 million to 1.1 billion (UNDESA, 2015). Furthermore, it is projected that in the year 2040, the urban population will be higher than the rural population in SSA, and this will constitute 55% of the entire population of the region. By 2050, SSA's urban population will certainly have tripled (UNDESA, 2015).

Currently, cities in the SSA region are experiencing unplanned urban growth in informal settlements where access to water is inadequate (UNDESA, 2014; Dos Santos et al., 2017; McDonald et al., 2011). This unequal growth will increase the demand for basic services such as water and will lead to millions of people experiencing a shortage of water. It is predicted that 24 million people with inadequate water supply in 2000 will increase to 162 million in 2050 (McDonald et al., 2011). The implication of this demographic shift will result in urban spatial inequality regarding access to water. However, Mitlin and Satterthwaite (2013) suggested that because urbanisation will increase and informal settlements without access to basic water services will grow, it is vital to deliberate on water access for the disadvantaged populations. Furthermore, the issue of urbanisation in terms of water access is peculiar to the South African setting. According to Parnell (2005) and Nleya (2008), regardless of the adoption of several policies aimed at addressing urban poverty in the post-apartheid era, South Africa has not avoided the crisis and many urban poor people who reside in informal settlements are faced with inadequate access to basic facilities such as, water, sanitation, and shelter, among other necessities.

2.8.1.2 Climate change

Climate change refers to significant changes in the statistical distribution of climate patterns such as temperature, precipitation, wind patterns, and other climate factors that occur over a long time. It is also connected, directly or indirectly, to human events such as the release of greenhouse gases that change the composition of the global atmosphere (UNFCCC, 2011; IPCC, 2014). Climate change is already affecting water access for people worldwide, causing more severe droughts and floods. The implications have been far-reaching. According to Cullis et al. (2015), climate change influences the water cycle by affecting precipitation falls. Climate change is likely to also impact water quantity and quality through higher temperatures and reduced freshwater flows. This requires strenuous efforts aimed at mitigating the effects of climate change and reducing greenhouse gas emissions, which, according to Beddington (2010), must be lowered by at least 50 to 60 per cent by 2050.

2.8.2 Micro determinants of access to water

2.8.2.1 Gender

Gender is a concept used in households and our sociocultural context to describe women's and men's characteristics, responsibilities, actions, and ways of thinking (UNDP, 2009; UNESCO, 2014). Gender characteristics are heavily influenced by how gender is interpreted and discussed in different cultural contexts because the understanding of the term differs across cultural settings. An insight into the explanation of gender is significant because it is a prerequisite for social analysis and the understanding of people's access to and distribution of essential services offered by society. The household often influences gender roles. For example, men are considered to be the head of the household. Financial responsibility is imposed on men, boys' education is regarded as a long-term plan, and resource ownership is perceived as a man's responsibility. On the other hand, women and girls are responsible for procreation and household chores such as laundry, fetching water, and cooking (Koolwal and Van de Walle, 2013; Rai et al., 2019).

Furthermore, Crow and Sultana (2002) indicated that gender relations might impact the social relations of water access in three different ways. The first relates to the gender-based divisions of work. The second relates to resource ownership and access, which in most parts of the world are owned and controlled mostly by men, particularly productive assets. Finally, but significantly, the policy discourse and local norms may place the economic uses of water at the behest of males and domestic uses of water assigned to females within a given domain.

The gender aspect in household access to water cannot be over-emphasised because inadequate access to basic water has a far-reaching implication, particularly for young girls and women. Apart from the responsibilities listed above, insufficient access to basic resources also hinders the chances of women been educated. Fisher (2008) stated that the lack of convenient, clean water supply and safe sanitation at the community level could be partly attributed to the inequality between the proportions of boys and girls who go to school. In an attempt to measure the direct advantages of local water availability for women and children, Nauges and Strand (2017) discovered that a fifty per cent reduction in water collection time increases the number of girls between the ages of 5 and 15 attending school in Ghana by 7%. The non-profit organisation water.org have further noted that women and children spend up to six hours per day collecting water for household use on average, in most cases dirty and unsafe water (water.org, 2011). This shows that women, particularly those in the rural areas, are more limited by the social, economic, and political constructs than men because access to water of quality is important for the livelihood of every woman faced with the responsibility of doing household chores.

UNICEF also conducted research in 25 Sub-Saharan African nations to assess how many hours' women in the region spend collecting water. According to the data, women in the Sub-Saharan region spend 16 million hours each day collecting water in total, and on average, women and children walk 10-15 kilometres per day to collect water, carrying up to 20 kilograms or 15 litres every trip (Caruso, 2017). In Kenya, women spend an average of 4.5 hours a week fetching water, while in Egypt, nearly 30% of women travel more than 1 hour a day to meet water needs, and in South Africa, women typically walk a total of an equivalent distance of 16 times to the moon and back every day collecting water for their families (UNICEF, 2017; UNIFEM, 2004). The Water Act of 1998 (DWAF, 1998) in South Africa is a progressive policy that aims to promote racial and gender equality in water access. However, according to Movik (2009), the policy's realisation and execution has been slow and flawed. Similarly, Muller et al. (2009) and Cullis and Van Koppen (2007) observed that reallocation of rights to water supplies in South Africa has progressed slowly, resulting in greater inequality in water access across race and gender. As a result, this study uses data from the 2018 General Household Survey to look at gender differences in access to water sources among South African households.

2.8.2.2 Education

The importance of education has been emphasised worldwide, and it has many advantages that cannot be overlooked in almost every aspect of life. It should come as no surprise that one of the most significant determinants of household access to potable water is household education, particularly that of household heads. Household water access decisions would change if education were improved, according to Larson et al. (2006). This is because households with higher levels of education are significantly more likely to have a private water connection than those with lower levels of education. Ortiz-Correa et al. (2016) established that. In contrast, there is a disparity in the amount of access to water, and there is also inequality in schooling as well as reduced academic success. When households are connected to improved water, children from inside such a household spend less time hauling and storing water. Kitamura et al. (2014) also mentioned that water and education are inextricably linked because education improves water literacy and water, in turn, affects educational conditions; thus, minimal education must be necessary, particularly with regard to information relating to safe water sources and water uses.

A number of studies have illustrated the influence of education on access to water. According to Ashaolu and Onundi (2014), schooling is a major factor in understanding how safe a water supply can be and what steps can be taken to ensure access to high-quality water. According to the study, more educated members of households continue to make an effort to provide clean water to their households. At the same time, those with only a basic or primary education will have trouble providing water from improved or unimproved sources. Uneducated households are more likely to ignore their water-sourcing practices, leading to other issues such as health problems. Studies have also revealed that highly educated household heads are more likely to access improved water sources. In contrast, uneducated household heads are more likely to only have access to unimproved water sources (Adams et al. 2016). Consequently, water access issues also lead to poor education of women and children, especially the girl child. According to Bartlett (2003), this is since they face the responsibility of gathering water and, in most situations, the amount of hours spent fetching water interferes with their school attendance.

In addition, Bosch et al. (2001) argue that the less an individual's educational achievement is, the more restricted their ability would be for them to seek and maintain better facilities from the authorities because they are powerless. Koskei et al. (2013), in their study on the effects of social-economic factors on access to improved water sources and basic sanitation in the Bomet municipality in Kenya, found that at a significance level of 0.01, the education of the household head significantly influenced the type of water source used by households. Adams et al. (2016) noted that well-educated households have better access to safe water and better sanitation facilities. In the same vein, Agbadi et al. (2019) reported that household heads who had at least completed middle-school education were more likely to have access to better sources of drinking water. In other words, household heads who do not have formal education are less likely to have access to potable water. In South Africa, Rhodes and McKenzie (2018) noted that the educational achievement of the household head was proportional to the access of piped water. Also, in a study of household willingness to pay for improved water in South Africa, Ngum (2011) suggested an association between the water source and level of education of the household head. This implies that those with higher education tend to have access to safe potable sources, and that the level of education is a significant factor.

2.8.2.3 Location of household

The geographical location of a household has been established as a factor that can affect water source choice. Households in urban areas are more likely to prefer and use improved water sources such as piped water and communal taps. In contrast, households in rural areas are more likely to use unimproved water sources. Owing to the unplanned nature of their settlements, urban households in slums or informal areas, while still located in urban areas, are more likely to have restricted access to piped water. It was noted in a report by UNICEF that there are often also striking differences in access within towns and cities, and people living in low-income, informal or illegal settlements or on the outskirts of cities or small towns are less likely to have access to an improved water supply (WHO/UNICEF, 2014). Furthermore, according to Franceys and Gerlach (2012), even though the majority of the urban poor live in slums, many of these areas are frequently deprived of access to water and essential services or face extensive administrative processes when it comes to connecting to official water supplies, partially due to a lack of assurances for land and infrastructure, as well as affordability issues. The water needs of deprived urban areas are rarely taken into account in urban and regional planning.

2.8.2.4 Income and income source

Another important determinant when ascertaining the type of life that household members lead is household income. Income regulates various aspects of their lives, including the type of accommodation, employment, health care, and water supply facilities, among others. In fact, income can be seen as a principal factor. According to Kujinga et al. (2014), household income influences equal access to water because households with more disposable income can afford private connections and pay for usage, while households with less expendable cash cannot do so. Akpabio (2011) posits that low-income households are more likely to rely on unimproved water sources because they are less costly. Similarly, there are arguments that affordability is closely linked with household socioeconomic status (income), so insufficient household income (or lack of entirely) may lead to households relying on unimproved water sources for their domestic uses (Fotue, 2013; Koskei et al., 2013).

Furthermore, other studies have suggested that the type of water source used by household was significantly influenced by the occupation of the household head. Smith and Hanson, 2003 (as well as Fotue et al., 2012; Kujinga et al., 2014; Mahama, et al., 2014) studied factors influencing 1500 households' access to improved water in low-income urban areas of Accra, and supported the opinion that income levels of households are among the main factors that determine access to water and sanitation facilities and services. According to Fotue (2013), when water is subsidised, it benefits wealthy households because they have access to the public network, while the poorer households may or may not benefit from such subsidies because their water supplies are unreliable or non-potable, forcing them to buy water from other non-subsidised sources. The implication of this is that households with no reliable source of income are most likely to use water from an unimproved source. South Africa, the study's central focus, is a middle-income country with uneven income distribution and income gaps, which have been evident in providing basic services. Dungumaro (2007) found that household income is a critical predictor of water access in his study, with data from a report on socioeconomic differentials and domestic water availability in South Africa. According to the findings, those who depend on salaries and wages as their primary source of income get their water from a piped tap in their home, a piped tap on-site, or a neighbour's tap. Those who rely on remittances rely primarily on public taps and households without income rely primarily on communal tap water. This shows that the source of household income affects access to better water (Dungumaro, 2007).

2.8.2.5 Time spent collecting water

In establishing the determinants that affect access to drinking water in South Africa or elsewhere, the time taken to walk to the water source or collection point is a significant factor to consider. In most cases, the amount of time spent collecting water is the most important factor in deciding whether or not anyone has access to clean drinking water. The amount of time it takes to collect water varies greatly across the world. For instance, according to WHO/UNICEF and their Joint Monitoring Programme (2019), collecting water in developing countries takes longer than in developed countries, especially in Sub-Saharan Africa, where more than a third of the population spends more than 30 minutes collecting water on a round-trip basis. Given the negative effects of long water collection times on livelihoods, the Sustainable Development Goals (SDGs) called for universal access to potable water by 2030, with the indicator being the proportion of the population with a round-trip water collection time of fewer than 30 minutes from an improved source (WHO/UNICEF JMP; 2015).

Researchers such as Bosch et al. (2001), Boone et al. (2011), and Graham et al. (2016) also analysed the time spent collecting water and suggested it is a significant factor in accessing improved water. In other research undertaken by Ako et al. (2010), it was found that the further a water source is from a dwelling, the more time is spent collecting water, and households would be able to live up to their daily requirements of 15 to 25 litres per person per day if the time to get potable water is between 3 to 30 minutes. However, beyond this time, the idea of collecting potable from improved sources is impeded. In contrast to this, Mahama et al. (2014) posits that in Lesotho, about 25% of households spend about 2.5 hours collecting water per day, while the majority of households in East Africa and North Cameroon spend close to 5 and 6 hours per day, respectively, collecting water for household needs. The acceptable basic level of service for safe drinking water in South Africa is piped water supply within 200 meters of a household, as specified by the South African Government (DWA, 1994). Even though the above is the expected travel time, Majuru et al. (2012) indicated that the actual round trip distance to water points, particularly in rural areas of South Africa, can be 600 meters or more.

2.9 Empirical Study of Socioeconomic Determinants of Access to Water

In recent years, researchers have paid increasing attention to providing access to clean and sufficient drinking water because it is tied to the objectives of sustainable development goals. As water supplies become increasingly strained as a result of societal demand, recognising the effects of global warming is critical for the effective management of this valuable resource. Duran-Encalada et al. (2017) used a conservative model to investigate the effect of global climate change on water quantity and quality in the US–Mexico trans-border area. The social indicators for this study were schooling, health, and housing. They stated that the study's approach can improve conditions and avoid threats that could lead to social instability and stifle economic growth. Another study on the effects of climate change on water supply found that water supply costs would rise in the future not only as a result of severe climate change but also as a result of higher demand (Bates et al., 2008).

In addition, Hopewell and Graham (2014) used Demographic Health Survey data collected between 2000 and 2012 to examine trends in access to water supply and sanitation in 31 major Sub-Saharan African cities. Explanatory variables such as improved water sources and time spent collecting water were used to assess patterns in water access. The findings revealed that there is an improvement in access to improved water supply in major Sub-Saharan African cities, but nearly half of the cities did not make progress in reducing the time spent collecting water. The study highlights the need to better define access beyond definitions of improved and unimproved water, as well as the need to target resources in cities where changes in water access have stalled, or in some cases, regressed. Tuyet-Hanh (2016) collected 2000, 2006, and 2011 secondary data from the Vietnam Multiple Indicator Cluster Survey to explain the trends and associations between sociodemographic variables and access to water over time, where descriptive statistics and binary logistic regression were used. The findings showed that households with access to water increased to 90% between 2000 and 2011. However, despite the progress in access to water, there were noticeable differences in access across regions, implying a need to address socioeconomic factors associated with insufficient access to improved water facilities.

In Western Africa, Egbinola (2017) used data from the Central Bank of Nigeria's annual reports and the Nigerian National Bureau of Statistics to analyse the trend in access to safe water supply in Nigeria. They found a high disparity in urban-rural access to improved water supply. They suggested that, while there has been a change in access to improved water supply between 1990 and 2015, with a rise from 48% to 69%, there is only increased coverage of improved water supply due to the alternative use of rain and well water as domestic supply sources. As a result, the study concluded that insufficient financing and management and low capital distribution in the water sector to urban and rural areas are the primary barriers to the improved water supply. The study also indicated a need to increase funding for water infrastructure in rural and suburban areas to expand access and close the inequality gap that still exists. Nnadozie (2011) provided an analysis of numerical trends in water service access and demand in post-apartheid South Africa using official data from the national household survey from 1995 to 2006 and census data from 1996 and 2001. The results, similarly, indicate that provinces have disproportionate access to water. For instance, among the nine provinces, the Eastern Cape, Limpopo, and Mpumalanga, with an existing low service level, had a low annual rate of delivery and percentage of access, rising slightly from about 68% to 70% in that time period. In contrast, in the North West, Northern Cape, and KwaZulu-Natal, where the existing service level is high, the annual rate of supply and percentage of access had risen marginally from 72% to 88%. However, Gauteng, the Western Cape, and the Free State, with initial favourable conditions, had a very sustainable annual rate of supply and very stable access at a value of approximately 98%. This study demonstrates that there is still a backlog in terms of the degree of access that needs to be addressed. Moreover, Behera and Sethi (2020) reviewed the detailed data from the Nepal Living Standard Survey (NLSS) for the 1995-1996, 2003–2004, and 2010–2011 periods to examine household access to drinkable water, sanitation, and waste disposal in urban areas of Nepal. They identified and analysed potentially significant factors of household access to drinking water using multinomial logit models. They found that older male and female, education levels, household wealth, and distance to markets are all important determinants of household access to safe and reliable drinking water. The variable age of the household head was found to be positive and meaningful at the 1% level. However, the age distribution was not defined. The coefficient of the variable, female-headed households, is positive but non-significant at the 10% level for the use of piped water; but it is negative and significant at the 5% level for the use of closed wells and hand pumps. Well and hand-pump sources of drinking water were positively and significantly correlated with household size. This finding implies that in Nepal's urban areas, female-headed households are less likely to have access to wells and hand pumps compared to households with more men, and households with more members are more likely to have access to wells and hand pumps compared to piped water sources, and the older the household heads are, the more likely they are to have access to piped water.

Persson (2002) described income, household size, and water price as significant factors influencing the household choice of drinking water source in the Philippines but did not investigate the impact of education, gender, or age. Similarly, Koskei et al. (2013) noted that the significant determinants of household sources of drinking water in Bomet Municipality, Kenya, were education, occupation, and gender of household heads, but age was insignificant. However, it is worth mentioning that these experiments were performed at the urban level, which may have affected the outcome of the results. Consequently, it is critical to investigate these variables at the national and broader geographical levels to observe how these factors influence the household choice for different sources of drinking water.

Fan et al. (2013) looked into the factors that influence domestic water usage in rural households in China's Wei River Basin. A total of 247 households were examined in eight villages along the Wei River. According to the study's results, per capita, domestic water consumption per day is significantly linked to water supply trend and location of the vegetable garden. A strong negative relationship was also discovered between family size and the age of the household head. Hygiene habits, the use of water equipment, and vegetable farming were identified as the prevalent behaviours in households with improved water supply. According to the report, consumer lifestyle and cultural backgrounds should be the subject of future research on rural domestic water use when developing water management plans for rural areas.

Abubakar (2018), focusing on differences between regions and populations, investigated the factors that affect household access to drinking water in Nigeria using the 2013 Demographic and Health Surveys. Chi-square and logistic regression were used to examine one dependent variable and 14 predictor variables. The Chi-square analysis was used to decide whether there are statistically significant variations in households' sources of drinking water and two or more independent variables. The logistic regression was used to predict the significant determinants of households' sources of drinking water. The findings revealed that households' sources of drinking water are significantly affected by residence, geographical location, education and gender, and state of residency (at p = 0.01). The results also showed that water collection time and the number of rooms are significant predictors of access to improved or unimproved water sources, as well as that the educational level of household heads, household income, ethnicity, and gender of the household head are determinants that significantly influence household drinking water supply and they show a strong statistical relationship. Osabuohien et al. (2012) conducted another study in Nigeria using micro-level data from a World Bank and National Bureau of Statistics survey of over 5,000 households and 27,000 household members across 36 states. According to the conclusions drawn from logistic regression analysis, the main determinants of household access to water are the age of the household members, marital status, the field in which the household member operates, the type of jobs, the number of working hours, access to informal means of financial credit, and the household's income level. Even though these studies used data from various sources, the results were similar.

Adams et al. (2016) examined whether socioeconomic and demographic characteristics are associated with access to potable water and improved sanitation facilities in Ghana using the 2008 Ghana Demographic and Health Survey. The seven independent variables in the study were wealth, education, number of household members, marital status, and gender of household head, geography, and place of residence. They used a linear regression model to demonstrate the significance of these variables on water. As a dependent variable, access to water was measured using the source of drinking water and the time it took to get to the source. According to the descriptive results, 85% and 15% of respondents used water from improved and non-improved sources, respectively. According to the bivariate analysis, female household heads are more likely than male household heads to have access to improved water sources. Those with tertiary and secondary school education have better access to improved water sources than those without education, but household size is negatively correlated with access to improved water sources. The argument is that households with no stable source of income are more likely to use unimproved water sources.

Rauf et al. (2015) designed a study to establish determinants of household drinking water supply choice in Pakistan's Punjab province. Using the household integrated economic survey from 2010 and 2011, the multinomial logit model was used to analyse the choice of the water source. Their findings indicate that the size of a family and the number of rooms in a home significantly impact the source of drinking water chosen. The respondents' location (rural/urban) is highly significant and has a positive impact on the choice of drinking water source, while the mode of transportation is significant but has a negative relationship with ownership of hand and motor pumps. Romano et al. (2014) estimated the determinants of residential water demand in Italy from 2007 to 2009 using a linear mixed-effects model estimated using the restricted-maximum-likelihood process. The findings showed that the imposed tariff hurt residential water consumption and was a significant factor of household water consumption. Drinking water was positively affected by per capita income. Climate and location, precipitation, and altitude all had a strongly negative impact on water consumption, while temperature did not affect water demand.

2.10 Perceptions of Water Quality

In the majority of countries, water safety is a major concern. People's perceptions of water quality are a major source of concern in developing countries, especially in South Africa, where water sources and sanitation remain inadequate. Price et al. (2019) noted perceived or actual water quality is the main driver in decision-making about drinking water. According to Noga and Wolbring (2013), Weisner et al. (2020), and Scherzer et al. (2010), perception of improved water sources at the household level is primarily influenced by organoleptic properties such as taste, odour, and clarity, which can influence the behaviour of household water consumption. The World Health Organization (WHO) acknowledges the importance of public participation in potable water safety studies. The public is the main beneficiary of safe water sources and the first to suffer the effects of deteriorating water quality (WHO, 2011). As a result, Weisner et al. (2020) indicated that much emphasis is placed on tap water's aesthetic qualities, particularly in the western world.

Consequently, The International Water Association stressed the importance of increasing the supply of potable water that consumers trust in its 2004 Bonn Charter for Safe Drinking Water. The Department of Water and Forestry describes water quality as water with an acceptable taste, chemical, and microbiological properties (DWAF 1996). The DWAF has further stated that the physical quality of water is influenced by the aesthetic properties, which include taste, odour and colour of the water. The WHO, a principal, and respected international health organisation, established drinking water quality standards that serve as a basis for other countries to formulate their own guidelines, hence the differences in standards across the world. The main purpose of this standard is to protect and promote public health. Furthermore, some countries have been able to formulate their own guidelines using WHO guidelines as a basis. For instance, after considering chemical, microbiological, and organoleptic factors, Europe established a quality standard for drinking water known as EU Drinking Water Directive (98/83/EC). In Africa, Botswana, for example developed a standard that specifies the water quality standard use in the country and further places penalties for a breach in standard (Ratikane, 2013). Finally, in South Africa, many acts and regulations are in place to ensure water quality, including the National Water Act of 1998, the National Health Act of 1997, and the South African Drinking Water Guidelines of 1996. According to the DWAF (1996), these guidelines decide the suitability of water for domestic use. Furthermore, the South Africa National Standards are a reference guide for acceptable numerical standards for drinking water quality in South Africa, regarding physical, microbial, aesthetic, and chemical quality (SABS, 2011).

Water quality is a global issue. However, this is a greater concern in developing countries, where the majority of the population still gets their water from unimproved sources that are polluted. This has both health and socioeconomic implications. According to Delpla et al. (2015), socioeconomic disparities are related to inconsistency in the quality of drinking water. Substantial progress has been made in providing drinking water in compliance with the South African National Standard (SANS) since 1994, which includes drinking water (Hodgson and Manus, 2006). The SANS require the provision of water that poses no significant health risk over the course of a lifetime of use. Despite this development, there are still backlogs in the provision of high-quality water. Furthermore, the World Health Organization's Guidelines for drinking water quality state that the drinking water's taste, colour, and odour must be acceptable to the general public. In line with this, the South African Government introduced the Blue Drop scheme in 2009 to educate the public about the performance of Water Service Providers and Authorities in terms of water quality (DWA, 2009; WHO, 2011). Doria (2010) also stated that a deeper knowledge of the processes that influence public perception of water quality will improve water management, customer services, acceptability of water reuse, and risk communication, among other areas. This may imply that a greater understanding of the perception of water quality in South Africa and elsewhere would help address the issues of socioeconomic disparities in access to water that may exist.

2.11 Determinants of Perceptions of Water Quality

Doria et al. (2005; 2009) and Doria (2010), Wright et al. (2012), Fotuè, (2013), and Bayeh and Bakele, (2018), investigated the determinants of perception of water quality. However, most of the study focuses on the organoleptic properties of water, including odour, smell, colour, water chemicals, and microbiological parameters. Wright et al. (2012) carried out research on the public understanding of the quality of drinking water in South Africa in the years 2002 to 2009 using a repeated cross-sectional analysis. The purpose of their analysis was to examine trends in perceptions of drinking water quality in South Africa. Data were drawn from the South Africa General Household Surveys and the relationship between perceived drinking water quality and organoleptic drinking water properties, supply characteristics, socioeconomic and demographic household characteristics were examined in 2002 and 2008 using hierarchical step-wise logistic regression. The findings indicate that perceived drinking water safety has remained fairly constant over time in South Africa and that perceived drinking water quality is mainly linked to the taste, smell, and clarity of the water. However, household socioeconomic or demographic characteristics such as household head, household head ethnic group, household head monthly expenditure, and education were insignificant to households' perceptions of water quality.

To understand the knowledge of the quality of water from improved and unimproved water sources, a study by Gebremichael et al. (2021) posed a question on taste, odour, and colour of the water supplied to the urban households in the North West area of Ethiopia. Of the 418 respondents, 107 noted that there was difference between improved and unimproved source of water with regard to taste, colour and odour, while about 305 respondents were unable to differentiate the quality of water from the different sources using taste, odour and colour. They noted that these factors cannot identify microorganisms and that using this identifier to differentiate water quality is cheap and a quick indoor practice. However, Doria (2010) revealed that people's perceptions of water quality significantly influence their water source selection. According to Doria, previous experience with the source, personal or impersonal information, sensory indicators like scent, taste, visual attractiveness, and cultural background and world-views are among the qualitative characteristics that influence the sense of water quality.

Bayeh and Bakele (2018) examined water quality in the rural/agricultural areas of Machakel District, North West Ethiopia. Structured interviews were conducted with 293 respondents to capture their views on water quality at the water source. Descriptive and ordinal logistic regression were used to assess factors affecting the perception of households on water quality. The outcome of the analysis showed that the majority of household heads used protected hand-dug wells, protected springs and protected shallow wells as their main source of potable water. Socioeconomic and demographic factors such as educational level of household head was found to have significant effect on the perception of water quality in a positive way, while the income of a household head affects the perception of water quality in a negative way at the source. This implies that education tends to enhance the way water quality is perceived while the income of a household might reduce the way water quality is viewed. Fotuè (2013) hypothesised that well-educated households are highly concerned with the health risks posed by using polluted water. A study sought to examine the impact of

Cameroonian households' awareness about the health effects of using contaminated water on their choice of adopting improved water sources. Data for their study was sourced from the Third Multiple Indicators Cluster Survey conducted in Cameroon and a bivariate probit model was used for the empirical analysis. The study concludes that household awareness of the adverse health effects of unimproved water influences utilising an improved drinking water source. Those households in the research who had previously heard sensitisation messages (at school or through the media) made steps to obtain drinking water from improved sources, reducing the risk of water-borne disease. The above finding was compared to undereducated household heads. The deduction was that the higher the household head's education, the more likely they chose a better drinking water source.

Totouom et al. (2018) conducted a study based on primary data collected in 2013 from a sample of 789 households in Douala and Yaoundé cities in Cameroon, to examine determinants of the avoidance behaviour of households in coping with unsafe drinking water. The nested logit model was used for empirical analysis. They concluded that the choice to improve water quality declines when the head of the household is a man and there is no child in the household. The decline is also seen when the wealth and the level of education of the household are low. This is because the coefficients of the different wealth dummies are negative and statistically significant because the more a household is poor, the less likely it becomes that they will improve their drinking water quality. Similarly, less educated households' heads are possibly less aware of the detrimental effects of consuming contaminated water and they will be less likely to improve their drinking water quality.

Weisner et al. (2020) used housing, education, employment, income, and immigration variables to investigate residents' perceptions of tap water, organoleptic properties such as odour, clarity, and taste, in order to identify overall satisfaction and consumption patterns in relation to social and economic inequality across Palm Beach County urban neighbourhoods. Kruskal-Wallis and Mann-Whitney tests were performed using SPSS to analyse the response variances of perceptions of tap water between socioeconomic groups; respondents were also asked to rate the odour, clarity, and taste of their tap water based on a 5-point Likert scale. The results showed that members of the population with the lowest socioeconomic status consistently rated the odour and taste of their water as poor. Delpla et al. (2015) conducted a study on social inequalities in exposure to drinking water contaminants in rural areas of Québec, Canada. The result shows that deprived rural municipalities are most likely to use simple (only chlorination), or no drinking water treatment.

Furthermore, in cases where households perceived that their water quality is poor, the household result to water treatment before consumption. This process is necessary to reduce the transmission of many waterborne pathogens, thereby preventing waterborne diseases. The treatment method used also has a significant influence on the removal of harmful impurities and improves the quality of water. A study carried out by Daniel et al. (2015), revealed that households who practiced water treatment had a small increase in their water quality, compared to those who did not treat their water and did not have any improvement in water quality. It is important to note that, from this study, although people's knowledge about water treatment methods was related to clean water at the point of collection, it was not the same with stored water.

On the other hand, a study by Guo et al. (2017) indicates that there was no significant difference between people who reported treatment of their stored water and those who did not. In addition, literature has shown that household perceptions of water quality vary significantly, depending on organoleptic, demographic, and socioeconomic factors. The choice of water source is influenced by one's perception of the quality of household water. It is also evident that research on the subject is limited, especially in the context of this study. As a result, this study aims to understand how organoleptic properties (taste, odour, and colour) and socioeconomic determinants influence household access to water, thereby adding to the field's existing literature. It is also important to mention the study conducted by Statistics of South Africa using the General Household Survey 2018 dataset. Table 2.2 below is from a 2018 GHS report and it displays the number and percentages of households in the province that are dissatisfied with the quality of their drinking water. The number represents the total number of households who showed dissatisfaction with their main source of drinking water. Even though the report excludes the 000s, the figures are in the thousands. furthermore, the results shows that the decrease in satisfaction is reflected by an increase over time in the percentage of households that reported their water was not clean, clear, tasted good, or was free of bad As shown in the table below, discontent with the quality of drinking water was most prevalent in the Eastern Cape, Free State, Northern Cape, and Mpumalanga in 2018, whereas Gauteng families were significantly more satisfied.

Table 2.2: Perceptions of households regarding the quality of the water they drink per province, 2018.

Perception	Statistic (Thousands)	Province									
		WC	EC	NC	FS	KZN	NW	GP	MP	LP	RSA
Not safe to drink	Number	145	232	48	89	198	102	111	176	38	1 141
	Percentage	7,8	13,8	14,1	10,0	6,8	8,5	2,3	13,7	2,5	6,9
Not clear	Number	116	190	47	125	179	133	125	161	49	1 127
	Percentage	6,2	11,3	13,8	14,1	6,2	11,1	2,6	12,6	3,1	6,8
Not good in taste	Number	147	260	48	75	180	141	146	182	122	1 300
	Percentage	7,8	15,5	14,1	8,4	6,2	11,7	3,0	14,3	7,8	7,8
Not free from bad smells	Number	119	163	37	96	161	92	132	140	103	1 043
	Percentage	6,4	9,7	10,8	10,7	5,6	7,7	2,7	11,0	6,6	6,3

Source: GHS, 2018 report.

2.12 Relationship between Accessibility and Quality of Water

Target 6.1 of the Sustainable Development Goals calls for universal and equal access to clean, safe and accessible drinking water (WHO, 2017). Clean and healthy drinking water is essential for human health. It can reduce the burden of common illnesses such as diarrhoea, mortality rates, out-of-school rates among children, especially girls, and promote countries' social and economic growth. Unfortunately, it was estimated in 2010 that 1.8 billion people worldwide consume poor-quality water, and 1.9 million depend on water from unimproved or polluted sources (Onda et al., 2012; Francis et al., 2015). According to Francis et al. (2015), the need for households to have accessible, high-quality water is critical to achieving the MDGs and SDGs. According to Waage (2010), overall progress toward the MDGs has been characterised as patchy and uneven. Similarly, Onda et al. (2012) and Bain et al. (2012) also stated that using an improved source as a proxy for quality water is likely to overestimate the population having access to quality water, since some improved sources may contain water that is microbiologically or chemically contaminated at the source or by the time it arrives at the household and is consumed. This is because the point of access to water does not imply better quality hence the inclusion of the word safe in target 7C of the MDGs.

There is a nexus between access to water and quality water because they are both pivotal in addressing the issue of development as well as human health, food, energy security, urbanisation, climate change, socioeconomic inequality, and poverty (Bos, 2016; Larson 2006). From the definition of potable water by WHO, it can be deduced that there are five normative values to potable water. It must be available, be of good quality, be acceptable, accessible and affordable for all, and each of these are interconnected with each other. Water for all and accessible for all implies that the distance between household water sources should be with reach for both children, elderly and the disabled. The source of water should be within 100 meters, or require an average five minutes collection time per day, as a criterion. In addition, the water must be of high quality, free of contaminants, and have moderate chemical levels (Larson, 2006). The adoption of United Nations (UN) Resolution 1 in 2010 recognising the human right to safe drinking water plotted a new path for universal access, and this right requires not only having access but also access to clean drinking water. This suggests that in order for a country to meet any of the MDGs' and SDGs' targets for water, water accessibility and quality must be measured simultaneously in order to plan better intervention programmes for all related water issues.

Water quality has been used by the JMP as a criterion for assessing 'safely treated water' (WHO/UNICEF, 2017). As part of this, a water quality testing module for inclusion in national household surveys has been developed (WHO/UNICEF JMP, 2015). This study aims to investigate perception of water quality through the use of secondary data from Stats S.A.

which will be used to analyse data with the help of a logistic regression model. This will aid in increasing awareness of national variations in access to clean water in the future.

As previously stated, South Africa is a semi-arid country with insufficient water sources, and supplying equitable, adequate, and high-quality water remains a significant challenge. According to the South African Council for Scientific and Industrial Research, almost 2.11 million South Africans do not have access to clean water resources. Access to clean and stable potable water is high in some of the major provinces, comparable to that found in developed cities; however, this is not the case in some provinces, towns, and most villages, where there is a constrained supply of potable water, and in some situations, the water supply system and surface water is often polluted (Edokpayi et al., 2017). To better understand the relationship between water access and water, Cook and Bakker (2012) argued that availability of water, human insecurity in the face of risks, human needs, and sustainable development are the four interrelated and overlapping factors that have dominated water research, particularly water security research. Improvement in access to water, therefore, requires the provision of good quality water.

2.13 Inequalities in Access to Water

Inequality is a key concern and an important agenda of the sustainable development goals. The UN General Assembly (2015) suggested that national data from Goal 5 and Goal 10 on gender inequality and income inequality respectively, must be broken down by income, gender, age, race, ethnicity, migratory status, disability, geographic location, and other factors important in national contexts to measure inequality. Cole et al. (2018) also stated that in South Africa, where inequality has been rooted since the 1900s, water and income data dissemination is very useful. Inequality in access to water is seen mostly across racial lines, gender, poor vs. rich, and geographical location (WHO/UNICEF, 2014; WHO/UNICEF, 2019; Truelove 2011; Dos Santos et al., 2017). In addition, the high disparities in the number of households with access to improved drinking water sources at regional, national, and sub-national levels pose significant barriers to meeting the SDG goal (Fuller et al., 2016).

Understanding the patterns of variation is an important first step in devising appropriate strategies to tackle all forms of inequalities in access to water. Geographical disparities in both developed and developing countries globally are a setback in achieving SDGs regarding access to improved potable water for all. Exploring geographic variations and inequalities in access to improved potable water and sanitation will help to track progress towards the SDGs (Azage et al., 2020). Statistics show that in 2017, there were disparities in drinking water and sanitation facilities across countries and regions. In the same year, for example, coverage of safely managed drinking water facilities ranged from 7% in Uganda to more than 99 per cent in 80 countries (UNICEF, 2019). Hasan and Alam (2020) noted that the highest variations across geographical locations in the access to water were observed in the countries from the SSA regions. In Ghana, for example, the Volta and Western regions had lower likelihoods of using improved drinking water sources than the Accra region, the national capital (Adams et al., 2016). In South Africa, geographical disparities are seen across the province. Cole et al. (2018) note that one of the main barriers to water access is geographic location disparities across South Africa provinces. According to Stats S.A. (2015), the statistics of households with access to piped or tap water in their dwellings, off-site or on-site by province, revealed that the Western Cape, Gauteng, Northern Cape, and Free State have higher proportions of households with access to water at 99.2%, 97.7%, 96.5%, and 96.1% respectively, compared to the Eastern Cape and Limpopo, which have access rates of 74.9% and 78.8%.

The JMP has been highlighting disparities in household drinking water across the past 25 years. Studies have further shown that water access for poor households is extremely low, leading to variation in access between the poor and rich. Poorer households are more likely to use unimproved water sources. In some settings, home water treatment is less practiced among poor households (UNICEF, 2017; Wright and Gundry, 2009). Similarly, Jiwani and Antiporta (2020) noted inequalities between the poor and rich, and the percentage difference between households with access to improved drinking water sources was observed for the countries in the Sub-Sahara (SSA). According to Hemson and O'Donovan (2006), delivery seems to have been poor and significant backlogs were identified in their study among poor households, especially regarding piped water. In addition, they noted that Black Africans with the lowest level of income had poor access to piped water. Furthermore, the World Bank noted that South Africa is also categorised by extreme wage inequality, noting that while wages have risen for skilled workers, the stagnation of wages for semi-skilled workers has fuelled wage inequality (World Bank, 2018).

Another pronounced variation in access to potable water is that between rural and urban areas. According to Bain et al. (2014), having access to water alone does not show complete inequalities between rural and urban areas owing to the fact that water may be unsafe and may not be available in sufficient quantities. Rural dwellers, however, tend to spend a longer time collecting water for the household. In an analysis of survey data from Sub-Saharan Africa, the WHO and UNICEF (2011) found that almost one in five rural dwellers had to walk at least 30 minutes to collect their water. In contrast, only 7% of the urban population did so. In terms of progress in access, Bain et al. (2014) noted that much more progress has been made in providing access to water to rural dwellers than urban dwellers; however, the slow progress in access to water might indeed arise as a result of urbanisation. For example, between the years 1990 to 2011, the urban population's percentage without improved sources decreased from 5% in 1990 to 4% in 2011. On the other hand, the rural population without access to an improved source reduced from 38% to 19% in the same year.

Furthermore, some systematic review further shows disparities in favour of urban regions. According to the UNICEF and WHO (2017), the global proportion of rural dwellers consuming unimproved water is two times that of the urban population. Living in an urban region increases the likelihood of using improved drinking water source, while living in rural areas increases the probability of depending on unimproved sources, including the use of surface water. In Indonesia and Vietnam, respectively, urban households were 2.6 and 2.2 times more expected to use improved than unimproved drinking water sources (Irianti et al., 2016; Tuyet-Hanh et al., 2016). Similarly, in Zambia and Ghana, 70% and 19% are likely to use unimproved potable water source respectively, compared to urban households (Adams et al., 2016; Mulenga et al., 2017). With regard to water quality, Miranda (2010) conducted a household survey in Peru which showed that rural supplies of the same type are more likely to suffer from faecal pollution than those in urban areas; Bain et al. (2014), also found that water quality is generally worse in rural areas. In South Africa, an analysis of spatial inequality in water access and water use by Cole et al. (2017) indicated that while 65% of urban dwellers have piped water in their houses, 34% of those living on farms and only 8% of the population living in traditional/tribal areas have this level of access. Ninety per cent of people with piped water in their dwelling live in urban areas, indicating that housing type is not a hindrance to water access, but rather the geographic location.

2.14 Conceptual Framework

The conceptualisation is based on a literature review and is consistent with the variables of interest and hypotheses formulated for the research. Household decisions about which potable water source to use are not static; they are influenced by various determinants such as household demographics, socioeconomic determinants, and households' perception of the physical water quality. The relationship between access to safe potable water and water quality perception can be thought of as a three-stage process in which a collection of determinants (water sources) influence a series of intermediate household determinants (demographic and socioeconomic variables), which in turn determine households' access to safe, potable water of quality.

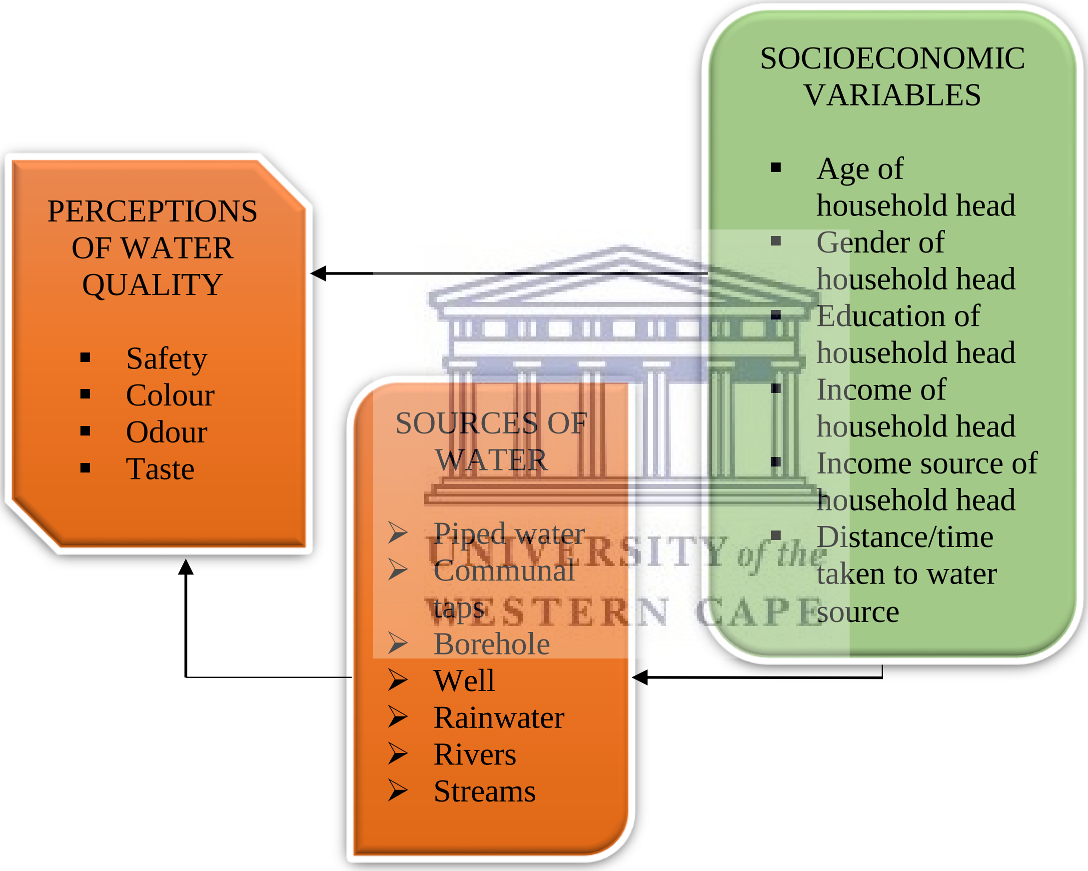


Figure 2.2: Conceptual framework. Source: Own compilation.

2.14.1 Gender influences on household access to potable water

Gender equality is one of the major aims of sustainable development. Understanding the influence of gender on households' access to water will help close the gender inequality gap in households' access to potable water. Studies have shown gender determinants, particularly the gender of the household head influences households' access to water. According to Sinyolo et al. (2018), in using improved water resources in the household, women are more efficient compared to men. Consequently, Pommells et al. (2018) argue that inadequate access to water has an effect on the entire population, influencing the role of women's daily activities. The long-distance between their homes and water sources exposes women to risk, and it is suggested that water be accessible and water points be safe for women and girls to access.

Abubakar (2019) examined the factors influencing household access to drinking water in Nigeria using 2013 Demographic and Health Surveys. Using descriptive and inferential statistics, the results indicate that the gender of the household head significantly influences the household choice of the source of drinking water. Similarly, Adams et al. (2016) conducted research on socioeconomic and demographic predictors of potable water and sanitation using the 2008 Ghana Demographic and Health Survey; the result also indicated there is a relationship between gender and access to potable water. The female-headed households were 1.21 times more likely to have access to improved water sources than male-headed households. However, Abebaw et al. (2010) pointed out that with a female household head, there is a higher probability that the household will use water from an improved source because women and children are the main members of the household responsible for fetching water and carrying out domestic chores. Contrary to these findings, Simelane et al. (2020), investigated determinants of households' access to improved drinking water sources with the aid of Eswatini 2010 and 2014 Multiple Indicator Cluster Surveys. The bivariate and multivariate regression analyses indicate that in 2010, the sex of the household head was not associated with access to improved drinking water sources. In 2014, female-headed households had lower odds of accessing improved water. It is therefore expected that male-headed households will have better access to safe water sources than female-headed households. On the other hand, females will have higher water quality perception.

2.14.2 Influence of education on household access to potable water

From the review of literature, educated heads of households are aware of the implications of accessing water from unimproved water sources or consuming water that is not safe from pathogens. Larson (2006) stated that improving education would alter household choices related to water access, water supply choice, and household water use. Larson (2006) further noted that in Madagascar, the education levels of household heads are reported to be fairly high for those with access to piped water. Similarly, Bruce and Tamlyn (2018), as cited in Rhodes and McKenzie (2018) and Adams et al. (2016) concluded in their studies that educational achievement of the household head was proportional to the access of piped water. In addition, Ashaolu and Onundi (2014) mentioned in their research that the level of education is a significant factor in understanding how safe a water source is and what measures can be taken to ensure access to high-quality water. Therefore, from the conceptual framework, this study predicts that the household head's education level will have a significant relationship with the choice of water source. It is also expected that household heads with a formal education will have a high probability of accessing safe water and also have better perception of water quality.

2.14.3 Influence of age on household access to potable water

According to Garcia et al. (2013), the age of the individuals within the household is an important explanatory variable for modelling domestic water use. The logistic regression analysis performed by Gebremichael et al. (2021) revealed a significant relationship between the age of the household head and the type of water source used. For example, the heads of households between the ages of 18–30 years show a higher likelihood of accessing improved water sources than those under the age of 18 years, and the level of access to an improved water source for those over the age of 45 years was lower. Other studies have established that there is a relationship between the age of the head of household and water quality perception. Similarly, Mulenga et al. (2017) found that 32.6% of household heads aged 15-34 years had access to improved water sources, 44.6% of household heads aged 35-54 years had access to improved water sources, and 22.8 % of household heads aged 55 and up had access to improved water sources. Furthermore, Leatt and Berry (2004) reported in an investigation into children's access to safe water in South Africa that there are approximately 7.7 million (43%) children whose households rely on unsafe or distant water sources. Contrary to these results, Garcia et al. (2013), discovered that the age of the residents is not a significant explanatory variable for modelling domestic water use, implying that older people are often affected by insufficient access. As a consequence, this research hypothesises that the age of the household head influences the household's water supply and perception of water quality.

2.14.4 Influence of income and income source on household access to potable water

Many consumer goods, such as water, have a positive correlation with household income and income sources. In most research, variable income is expressed as the net amount of money received by a person or household per unit of time. Other studies have used a house's property value as a proxy for its residents' economic status. For instance, Koskei et al. (2013) used household expenditure (proxy of household welfare). UNICEF reports that households in the lowest income group are 5.5 times more likely to lack access to better water than households in the highest income group in the same country, which is similar to the findings of Totouom and Fondo (2012). The research argued that as households become wealthy, they are more likely to choose good quality water. With respect to income sources, Dungumaro

(2007) identified income sources such as salaries and wages, remittance, pensions and grants, sales of farm production, and other non-farm income sources as a strong determinant of access to water. From the study, it is expected that income and sources of the household will influence access to water sources.

2.14.5 Influence of time spent collecting water on household access to potable water

The time it takes to walk to the water source or collection point is a significant factor to consider when analysing the factors that influence access to drinking water in South Africa or elsewhere. Collecting a few litres of water will take a long time in some cases because water points are several kilometres away from home. Researchers such as Bosch et al. (2001), Boone et al. (2011) and Graham et al. (2016) examined and proposed that the time spent gathering water is a major factor in gaining access to better water. Time spent is often used as a rung on a ladder to measure access to water and perceptions of water quality. According to WHO and UNICEF, the time spent traveling to and from a water source should not exceed 30 minutes. However, this is not the case in many countries, especially in rural areas, where there is insufficient access to improved water supplies. The conceptualised framework demonstrates that the time/distance travelled to the water source affects the household's choice of water.

2.15 Chapter Conclusion

This chapter conceptualised water access and water quality perception. It began by defining the terms availability, scarcity, and security of water. It went further to conceptualise water availability by providing a global perspective and then streamlined it to the context of South Africa. The various water sources available to households, their usage, and sourcing behaviour were thoroughly discussed. The determinants of access to water were classified into two parts: macro and micro determinants. Macro factors that affect the entire population include economic, political, and environmental concerns, whereas micro determinants deal with the families' economic situation, such as education and income. In addition, an in-depth discussion of water as a human right and as a key issue for sustainable development was explored. The perception of water quality in relation to the physical properties of water was also explored. To conclude the chapter, the relationship between accessibility and water quality, water determinants that influence household access, and perceptions of water quality were explored, and a conceptual framework was constructed based on the reviewed literatures.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the methodology used for the study and explains the research processes employed throughout the study. The study's methodology is vital because it systematically helps to answer the study's research questions. According to Novikov and Novikov (2013), the methodology of a study is described as the arrangement of activity, which involves organising an integral tool with a clearly defined research approach and characteristics and the accompanying method of its realisation and the temporal organisation. This chapter, therefore, begins with a detailed explanation of the research setting and design, sources of data and method of data collection. Finally, it describes the systematic procedures for data analysis. Furthermore, all variables used in the study are described. The statistical methods used to measure the influence of the demographic and socioeconomic determinants on households' access to safe drinking water and perceptions of water quality are discussed.

3.2 Research Setting

The study used census data obtained from the South Africa General Household Survey (GHS) conducted in 2018. In the survey, 233 enumerators, 62 provincial, and district coordinators participated in the study across the nine provinces. An additional 27 quality assurors were responsible for monitoring and ensuring that the questionnaire used was of good quality. In the survey, the country was first divided into 103576 enumeration areas (EAs), known as the frame unit. However, since it covers the whole of South Africa, the selected primary-sampling units (PSUs) in the master sample was 3324, with an expected sample of approximately 33000 dwelling units (DUs). The master sample is designed to be representative at the provincial level and within provinces. Therefore, the larger master sample of PSUs was selected to improve the precision. Finally, the 20905 households include multiple households which were successfully interviewed.

3.3 Study Design

In this study, a cross-sectional survey design was used to assess households' access to water and perceptions of water quality in South Africa. According to Bethlehem (1999), a cross-sectional survey is used to analyse the state of affairs in a population at a specific point in time. The survey target group may not have to be individuals; households, farms, or businesses. Usually, survey data is gathered using questionnaires. This design was chosen because it accommodates a large number of study participants, it is relatively quick and many researchers, particularly in the fields of statistics and population studies, use it when conducting quantitative studies.

3.4 Sample Design

This study made use of a multi-stage, stratified probability sample. The stratification of the sample was done across nine provinces of South Africa. The design included two stages of sampling. In the first stage, primary sampling units (PSUs) within the strata were selected systematically using Probability Proportional to Size (PPS) sampling methods and the primary units were defined by the area type (urban and non-urban geographical area), while in the second stage, dwelling units (DUs) were systematically sampled from the sampled primary sampling units (PSUs). During secondary stratification, the 2001 Census data were summarised at PSU level. Furthermore, a Randomised Probability Proportional to Size (RPPS) systematic sample of PSUs was drawn in each stratum, with the measure of size being the household's number in the PSU. In total, a selection of 3 080 PSUs was made, and in each selected PSU, a systematic sample of dwelling units was drawn.

3.5 Sampling Weights

Sampling weights were used to weigh sample data in order to correct for sample disparity in relation to the target population of interest (Pfeffermann, 1993). The sampling weights represent uneven sample inclusion probability and adjust for non-response and under-coverage. Weight is typically included in the released survey data files. This study made use of a dataset provided by Data First and is based on the 2018 General Household Survey (GHS) (Stats S.A., 2019). The GHS data is a two-stage stratified design. The sampling weights are included in the GHS data to help rectify the generated samples, which are not necessarily representative of the target population due to non-response, non-coverage, and under-representation of specific demographic groups. According to Luus (2016), sample weights are used to restore the original importance of each group within the population. Therefore, in order to obtain a true representation of the overall population under study, the sampling weights were considered.

3.6 Unit of Observation

The household is the statistical unit of observation in this study. According to Wutich et al. (2017), the household is a basic social unit for resource pooling and sharing. However, the ability of each household to access services, including water, varies. Socioeconomic determinants such as educational level, income, and age structure of household head has influence on household access to water and water quality perception. The data used in this analysis was collected from randomly selected households in South Africa. These responses were extended to reflect the entire civilian population of South Africa, the study area.

3.7 Units of Analyses

The statistical unit of analysis according to Sedgwick (2014), is the 'who' or 'what' that applies to which data is analysed and from which conclusions are drawn. In this study, the unit of analysis is the 'household head'. The information on the household heads' socioeconomic variables was collected from the 2018 general household survey, and a statistical analysis was conducted and conclusions were drawn based on the socioeconomic information obtained from the household head.

3.8 Methods

3.8.1 Data source

Secondary data was used in this study, which was sourced from the South African General Household Survey (SAGHS) 2018. The General Household Survey (GHS) is a yearly household survey conducted by Stats S.A. The GHS started in 2002 and it was used as a replacement for the October Household Survey (OHS), which started in 1993 and ended in 1999. The survey is a regular collection of household-based instruments aimed at assessing the country's progress level. The assessment of the programme performance, as well as the quality of service delivery, is based on the main service sectors in the country, which includes education, health, and social development, housing, a household's access to services and facilities, food security, and agriculture.

3.8.2 Method of data collection

A questionnaire was used in the collection of the 2018 GHS data. Information of people who lived in the sampled household for four nights on an average and in the past weeks was obtained. The questionnaire had a total number of 210 questions, excluding the questions of the interviewers. The questionnaire was grouped into nine different sections, and they were as follows:

Particulars of the dwellings: The cover page, household information, response details, field staff information, result codes, etc., were contained in this section.

The flap page: This contained some important demographic information such as name, gender, age, population group, etc., of every person in the household.

Section 1: Information on household characteristics that included relationship to head of each household member's household and education status.

Section 2: Information on health and general functioning. All household members were asked health-related questions.

Section 3: In this section, all household members were asked questions relating to social security (social relief and disability grants).

Section 4: Information on economic activities. Information on economic activities was asked of household members who were 15 years and older.

Section 5: General household information and service delivery. A responsible person within the household was asked questions relating to housing, water, sanitation and hygiene, energy, waste management and refuse removal, recycling, and environment. In this study, Section 5 is vital, as most of the information used in the analysis is extracted, grouped and classified into different classes.

Section 6: Communication and transport. All members of the household were asked questions relating to household appliances and internet services.

Section 7: Health, welfare, and food security information relating to public sectors such as public health centres were obtained from the household.

Section 8: Household livelihood. In this section, information relating to agricultural production, household income source, and expenditure was obtained.

Section 9: Mortality in the last 12 months. Information on all household members who had lost their lives was collected.

Section 10: Interviewers' questions, particularly on dwelling type and language in which the interviews were conducted.

3.9 Description of the Variables of Interest

The variables of interest were collected explicitly for the household head because it is the primary unit of analysis in the study. SAGHS 2018 variables were obtained and classified into four groups. This includes demographics, socioeconomics, perceptions of water quality, and water source. A detailed description of key variables follows below.

- Location variables: province of residence
- Demographic variables: Age, gender and education
- Socioeconomic variables: Income (monthly), income source
- Perception of water quality variables: Taste, colour, and odour.
- Water access variables: household's main water source and and distance/time taken to access water
- Place of residence

See Appendix 5 for South African provinces according to the provincial boundaries as classified in December 2005. This variable will help to determine if there are disparities in water access between the provinces.

3.9.1 Household head demographic variables

According to the reviewed literature, three main demographic variables were selected. Their description and coding in the questionnaire are as follows:

3.9.2 Age groups

The age of members in the household, particularly the age of the household head were asked. The question in the questionnaire, "What is your birth date and age in completed years?" The enumerators was instructed to write the completed years as integers (60) and not in words. It was important for these years to be completed years, thus, if a person in the household was two years and six months, the enumerator was instructed to write two years, while for those children who were less than a year old, the instruction was to write 00. Finally, these were recoded into groups and captured using SPSS. See Appendix 6 for variable description.

3.9.3 Gender

To determine gender in the household, this question was asked: "Is the member of the household male or female?" The enumerators were given an instruction not to assume the gender of members of the household by looking at people`s names or physical appearances. The gender of the head of the household was further obtained by assigning them the gender of the household member who indicated him or herself as head or acting head of the household. The gender variable was re-coded see appendix 7.

3.9.4 Education

To determine the highest level of education of the household head, the question was asked: "What is the highest level of education that a person in the household has completed?" This question was asked of all members of the household. It was very important to complete each record, even if the person had not attended school. In addition, enumerators were instructed that diplomas and certificates had to be at least for six months old and answers were record See appendix 8.

3.10 Household Head Socioeconomic Variables

3.10.1 Income of household head

The question on income was asked of household members involved in economic activity (labour force). These household members were aged 15 years and older. Since this is personal information, enumerators were instructed to inform respondents that Acts are provided to protect the individual. The question asked was: "What is the total salary/pay at your main job?" The amount was given in range and interval. Income was converted to monthly income and recorded See appendix 9.

3.10.2 Income source

This question applied to all households in the study area to determine their main source of income. In the questionnaire, different sources of income were listed and the household was asked: "Which one of the listed income sources is the main source of income?" The responses were recorded see appendix 10.

3.10.3 Distance/time taken to water source

Households without access to water on site or in the dwelling were asked this question. The aim of the question was to determine the distance covered by household members to obtain water from their main source, and the enumerators were required to consider the distance covered using the usual means of transport to this source. In the questionnaire, the household was asked: "How far is the water source from the dwelling or yard? (200m is equal to the length of two football/soccer fields)" and the following was recorded See appendix 11.

3.10.4 Perception of quality of drinking water

All households in the selected dwelling units were asked about their perception of the quality of their drinking water. The question was asked: “Is the water from the main source of drinking water before any treatment?” and the option was given in a Yes or No format. For instance, 1 = Safe to drink? 2 = Clear (has no colour/free of mud)? 3 = Good in taste? 4 = Free from bad smells? Yes/No, and the final codes were recorded See appendix 12.

3.10.5 Water source

This question was asked of household heads in the selected dwelling units to determine the household’s main source of water. The nature of this question helps to better understand the water sourcing behaviour of many households in South Africa, and it can then indicate whether the majority of households receive water inside their dwellings, on their sites or at communal areas or elsewhere. Those with two sources were asked to indicate the sources. See appendix 13 for the final codes.

3.11 Ethical Considerations

According to Head (2020), when conducting research in a professional and academic context, one must be conscious of the ethics that underpin the research, and ethical concerns specified by any organisation or institutional review boards are required in any type of study. This implies that ethnical consideration in research is mainly concerned with the methods of protecting the rights and welfare of the participants and the sample population participating in the research process. It is critical, therefore, to adhere to ethical principles in any research. Furthermore, it is also of uttermost importance to identify any ethical difficulties that may arise throughout the studies ahead of time, so that they can be dealt with accordingly. The 2018 General Household Survey data was utilised in this study and permission was obtained before analysing the data. This data was gathered using surveys and it is worth noting that data collected by Statistics South Africa (Stats S.A.) is in accordance with all ethical standards. The identities of individuals are not mentioned in the questionnaire, and permission was obtained before collection of data was carried out.

3.12 Data Analysis and Statistical Procedures

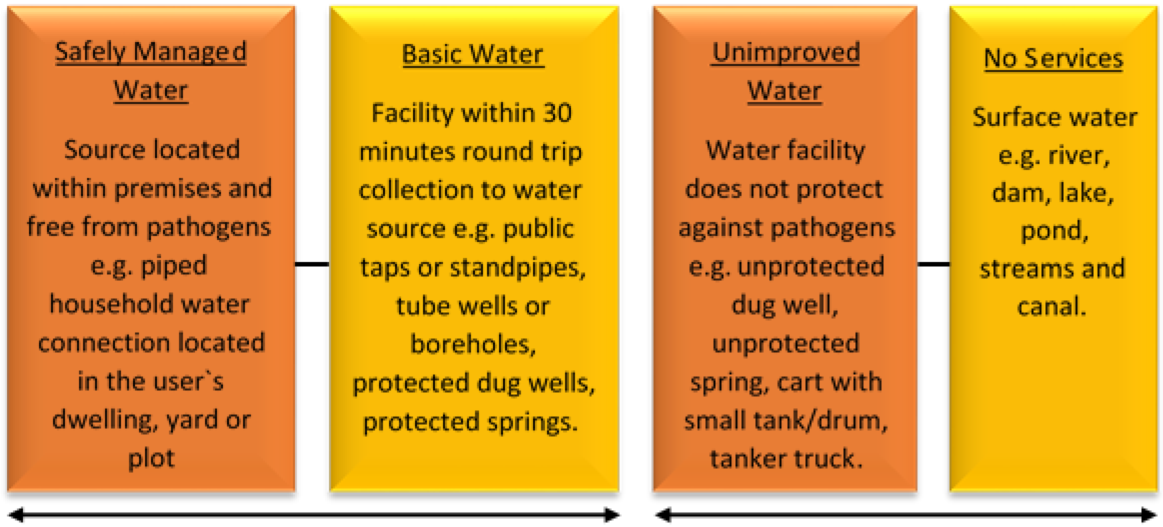
This section explains data procedures, the different types of analysis employed and how the methods have been applied to answer each research question and hypothesis in the study. Data was obtained from Data First and was based on the 2018 household survey conducted by the South Africa General Household Survey (GHS). The dataset included two different datasets (person and household dataset). In the person dataset there are 71 137 observations and variables are at the individual level, while in the household dataset there are 20 908 observations and it comprises of variables at the household level. The two data files also contain some derived variables. Although, the study evaluates access to water and perceptions of water quality at household level, the person dataset has been merged with household dataset to extract data relating to the household head in the person's dataset and to form a cross-sectional dataset. Some of the merged variables are educational level and income. This process allows for all individual characteristics (such as gender, age and education) of the household members, in particular the household head, to be included in the study. The dataset was download in the SPSS format, no missing values found, and thus no adjustment was done. Finally, SPSS software were use in analysing the data.

The methods utilised for the study are both descriptive and inferential statistical methods. Frequency distribution and cross-tabulation of independent variables and dependent variables, Pearson chi-square, analysis of variance and logistic regression were employed for data analysis, aided by SPSS. Chi-square is an appropriate analytical technique that is used to determine whether statistically significant differences in household drinking water source exist between two or more independent groups. Logistic regression is used to predict the significant determinants of household drinking water sources, the outcome variable is recorded into a binary for proper analysis and a multivariate analysis is also, used to determine the likelihood of access to improved water source.

The extracted data from the 2018 General Household Survey was used for this analysis, based on the study's main research questions, which are as follows:

- What relationships exist between access to water and socioeconomic variables such as distance to water source, age, gender, population group, education level, monthly income, and income source of the household head?
- Is there any relationship between perceptions of water quality and socio-demographic variables (such as age, gender, and monthly income of household heads)?

These independent variables and their influence on households' water sources were identified based on published literature and the current situation in the area that is useful in the explanation of the variations in the dependent variables. In conceptualising the dependable variable (water source) for this study, the Joint Monitoring Program (JMP) ladder for measuring safely managed water was adopted. This is because the JMP ladder is more accommodating in tracking a population's access to potable water over space and time. Each rung on the ladder represents a different level of access. The figure below shows the JMP-conceptualised, safely managed water.



Improved water sources **unimproved water sources**

Figure 3.1: 2015 JMP ladder concept for the analysis of water access. Source: JMP, 2017, P.1-56.

The analysis and methods selected are based on the stated research objectives, questions and hypotheses. The following section shows how these objectives, questions and hypotheses will be addressed.

Objective 1. Determination of the proportion of households with access to improved water sources in South Africa and its regional variations (i.e. how it varies across provinces, as well as rural-urban variations)?

The first step is to identify the various sources of water using the variable ‘drinking water source’, the details of which are stated above. As shown in Figure 3.1 above, the data was categorised using the 2015 WHO/UNICEF Joint Monitoring Programme (JMP) method. The JMP is an official UN mechanism entrusted with monitoring water and sanitation progress. The JMP created this water ladder to provide a clear understanding of water access that goes beyond the MDGs' classification of access to improved and unimproved water, incorporating technological innovations and measuring the quality of drinking water as part of household surveys, and this has helped to distinguish access to water. Furthermore, this ladder allows for a disaggregated assessment of trends in access to water on four rungs (see Figure 3.1), and this method can be applied to this study, which looks at household water access and quality perceptions in South Africa.

To answer this question, SPSS software was used to record the variable water source according to different variables. A descriptive analysis of water sources was performed to show the frequency distribution of water access. A pie chart was used to show the frequency analysis of access. This provides a clear picture of the proportion of South Africans who have safe drinking water. To gain a better understanding of how access varies by province and geography type (urban/rural), the source of water was then cross-tabulated with the province and geography type. The results were then compared to Statistics South Africa's GHS 2018 report.

Hypothesis 1: Households headed by females are less likely to have access to improved water sources.

To verify this hypothesis, the variables of interest (gender of household head and source of water) were identified in the dataset. A frequency analysis was first performed on the sex composition of the household head; this was to aid in providing a clear picture of the proportion of household heads who are male or female. A cross- tabulation analysis between gender of household head and main source of drinking water and the proportion of access was then reported. Since the variables are categorical, a binary logistic regression between the gender of the household head and the sources of water was used to determine if the hypothesis is true or false. The presentation of results are then also in charts and tables.

Hypothesis 2: There is a relationship between households' sources of income and access to improved water sources.

The variables of interest for testing this hypothesis are the household head's sources of income and main source of potable water. To examine this variable, descriptive cross-tabulation was used to show the proportion of households with access to water based on the household head's income source. The chi-square test of association was used to determine whether there is an association between these variables. These variables were then also analysed using binary regression analysis because the predicting and outcome of variables are categorical variables. The binary logistic then showed the relationship across each income source category and the likelihood of access to improved or unimproved water sources across the income sources.

Hypothesis 3: The monthly income of the household head influences access to potable water.

To test hypothesis three, the variables of interest (household head's monthly income and water source) were identified in the dataset. The variable monthly income was recorded using metadata; this variable was coded in such a way that it did not interfere with the original coding done by STATS S.A.. This implies that no response and unspecified were not altered in any way, but are excluded from the report. Binary logistic regression was used in testing the hypothesis because the variables of interest are categorical. The household head's monthly income and the main source of potable water were also cross tabulated to illustrate the proportion of people who have access to water in each income group. Tables were used to present the results.

Hypothesis 4: There is a relationship between the level of education of a household head and access to an improved water source.

The variables and interest (level of education of household and income source) were identified in the dataset before hypothesis 4 was tested. The level of education was divided into 31 groups in the dataset, with unspecified and no response options included. Levels of education were recorded in terms of different variables for the purposes of this study and were grouped into six levels of education, excluding the unspecified and no response groups. A cross-tabulation was performed to show the percentage of access at each level of education. The chi-square test of association was used to determine the association between access to water and level of education since they are nominal variables. Cramer's V statistic was used to determine the strength of association. To further test the hypothesis, binary logistic regression was performed. This was to aid in demonstrating the relationship that exists between each level of education and the likelihood of choosing an improved or unimproved water source, as well as whether the hypothesis should be accepted or rejected.

Hypothesis 5: Access to potable water sources is associated with the population group of the household head.

The demographic group of household heads and water sources are the variables of interest. South Africa is divided into four ethnic groups. To determine whether the association between water sources and the demographic group of household heads exists, cross-tabulation and the chi-square test was performed to analyse the data in order to refute or accept the hypothesis. Because variables are nominal variables, Cramer's V statistic was further use to determine the strength of association. To further test the hypothesis, binary logistic regression was performed. This was to aid in demonstrating the relationship that exists between the different population groups and the likelihood of them choosing an improved or unimproved water source.

Hypothesis 6: There is an association between the distance to water and the gender of the household head.

To test this hypothesis, variable distances travelled to a water source and the main source of drinking water were identified in the dataset. These variables were already coded into different groups. To begin the analysis, a cross-tabulation was used to examine the variables. This was to illustrate the proportion of male and female household heads who travelled significant distances to collect water and to show how this differs by gender. Because the variables are nominal, the chi-square test of association was performed to test the association between the variables under investigation, while Cramer's V statistic was used to measure the strength of the relationship. Furthermore, the average distance travelled to access water was calculated and, the mean distance was used to perform ANOVA. The different method of analysis was to assist in the confirmation or rejection of the hypothesis indicated above.

Hypothesis 7: The province of residence and geographical settlement area influences a household's perception of water quality.

To test for perceptions of water quality and how this varies across province and geographical area, the different perceptions of water quality were identified and they include: safety, taste, clarity and odour of main source of drinking water for the household. Province and geographical settlement area variables were identified in the dataset. Descriptive cross-tabulations were performed to identify the proportion who perceived their main source of water as safe or unsafe, free or not free from bad smells, clear or unclear and good or bad taste. These results are displayed in table format in the next chapter.

Hypothesis 8: There is a relationship between the age of a household head and their perceptions of water quality.

To investigate the association between the age of the household head and perceptions of water quality, perceptions of water quality were coded in terms of binary variables. A cross-tabulation was performed between the age of the household head and perceptions of water quality to demonstrate the proportion of perceptions of water quality across each age group. Data was also analysed using the logistics regression method. This was to aid in determining whether there is a relationship between the age of the household head and perceptions of water quality.

Hypothesis 9: There is a relationship between the monthly income of a household head and their perceptions of water quality.

The monthly income of the household head is one of the key variables for this study. As previously mentioned, households perceive their water in a variety of ways. To establish the percentages of perceptions of water quality across income groups, a cross-tabulation was performed between monthly family income and perceptions of water quality. The logistics regression method was also used to examine the data. This was to aid in determining whether there is a relationship between the household head's monthly income and their perceptions of water quality, in order to reject or accept the hypothesis.

3.13 Descriptive Analysis

According to Mishra et al. (2019), descriptive statistics are used to summarise a set of observations in order to communicate the largest amount of information as simply as possible. There are different types of descriptive analysis data, and they include measures of frequency (frequency, percent), measures of central tendency (mean, median, and mode) and measures of dispersion or variation. However, for this study, measures of frequency, tables and charts was specifically used to identify household characteristics and relate them to access to water. Furthermore, The GHS question on piped water asks households to identify their main source of drinking water. Among the responses are piped water inside the dwelling, in the yard, from a neighbour’s tap, from a communal or public tap, from boreholes, from a rainwater tank and well, and many more. For this study, the variables representing access to piped water are coded into binary variables. Equal to one, if a household is classified as having access to piped water within their home, yard, neighbour’s tap, or communal/public tap, and zero for all other water sources. This will aid in answering the research questions.

3.12.1 Chi-square analysis

The chi-square analytical technique was used to determine whether statistically, there are significant differences between household drinking water sources and two or more independent groups. The model is as follows:

$$\sum_{i=0}^{K} \frac{(O_i - E_i)^2}{E_i}$$

Where

O_i = Observed frequencies

E_i = Expected frequencies.

3.13 Multivariate Analysis

A multivariate analysis is a series of procedures for analysing the relationships between two or more sets of observations. Since a series of univariate analyses does not demonstrate associations among the variables under study, multivariate analysis is adopted. The aim of a multivariate analysis is to assess whether certain socioeconomic factors influence household access to improved or unimproved water sources. There are different types of multivariate analysis, but for the purposes of this study, a Logistic Regression Analysis was employed. When the dependent variable is categorical and may be ordered or unordered, the use of logistic regression is very efficient (Adeniyi and Dinbabo, 2019; Mernard; 2010). Osborne (2012) and Adeniyi and Dinbabo (2019) note that when the outcome to be predicted is categorical, logistic regression is useful.

The independent variables in logistic regression can be interval, ratio, or dummy variables, which are variables whose group is smaller than those variables at the interval or ratio level (Adeniyi and Dinbabo, 2019). As a result, binary logistic regression is an effective statistical technique for analysing the relationship between categorical dependent variables and one or more independent variables. Since the dependent variables in this study are categorical, the household decision to use improved or unimproved water source is estimated using a logistic regression model.

The following binary logistic regression model is adopted from Adeniyi and Dinbabo (2019), Danquah (2015), and Zbinden and Lee (2015).

$$\text{Logit}(y) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n + \epsilon_I$$

Equation 3.1

Interpretation:

Y is the binary outcome

Logit (y) is the natural logarithms of the probability of y

α is a constant term that corresponds to the value of Logit (y) when all X_n are equal to zero

$X_1, \ldots, X_n$ are independent variables with associated coefficient $\beta_1, \ldots, \beta n$

When the values in the outcome variables are coded 1 and 0 respectively, P1 and P0 are the odds of being in group 1 or 0 and the probability is as:

The probability of being in group 0:

$P_r(y=0) = 1 - p(y=1)$

Equation 3.2

The probability of being in-group 1:

$P_1/P_2 = P_1/1-P_2$

Equation 3.3

Logit (y) which the natural logarithm of the probability of selection is

In $[P_1/ (1-P_1)]$

Equation 3.4

Where "In" is the transformation of the natural logarithm (Zbinden and Lee, 2015)

Empirical modelling of the logistic regression equation for the study:

This model is based on the socioeconomic determinants that are hypothesised to influence access to a water source, and it is given as

$Y_i = \beta_0 + \beta_1 \text{Age} + \beta_2 \text{Gender} + \beta_3 \text{Edication} + \beta_4 \text{Income} + \beta_5 \text{Income source} + \beta_6 \text{distance to water source} + \boldsymbol{\epsilon}$

3.13.1 Model for perceptions of water quality

A Logistic Regression Analysis is also used to examine the relationship between different perceptions of water quality and socioeconomic characteristics. Since the response variables under examination (safety, taste, fragrance, and water colour) are binary (yes or no), the model for perceptions of water quality is shown below using the same equation and interpretation as the logistic regression above:

$\text{Logit (y)} = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n + \boldsymbol{\epsilon}_I$

Where

Y = dependent variables

$X_1 \ldots X_n$ = independent variables

β **=** regression coefficients to be estimated

ϵ **=** error or residual term of the model**.**

The logistics regression model for water quality perception is as follows:

$$\text{Logit}Y_{(safe)} = \beta 0 + \beta_1 \text{gender} + \beta_2 \text{age} + \beta_3 \text{monthly income} + \epsilon$$

Equation 3.5

$$\text{Logit}Y_{(taste)} = \beta 0 + \beta_1 \text{gender} + \beta_2 \text{age} + \beta_3 \text{monthly income} + \epsilon$$

Equation 3.6

$$\text{Logit}Y_{(clear)} = \beta 0 + \beta_1 \text{gender} + \beta_2 \text{age} + \beta_3 \text{monthly income} + \epsilon$$

Equation 3.7

$$\text{Logit}Y_{(smell)} = \beta 0 + \beta_1 \text{gender} + \beta_2 \text{age} + \beta_3 \text{monthly income} + \epsilon$$

Equation 3.8

3.14 Chapter Conclusion

The chapter has provided a comprehensive explanation of the research methods that have been employed for the study. The research made use of descriptive and inferential statistics. More specifically, the study has used binary logistic regression to find the relationship between the dependent and independent variables, since the research involves the investigation of quantitative data derived from the 2018 General Household Survey. Included in the chapter, socioeconomic variables under investigation are clearly stated and the ethical statement, which is an important requirement for performing research. In the next chapter, the methods of analysis are employed to provide closure for the research.

CHAPTER FOUR: DATA ANALYSIS

4.1 Introduction

This chapter focuses on the statistical indicators that were calculated using data from the 2018 General Household Survey. The study's main objective is to investigate the relationship between household socioeconomic determinants and access to water, as well as the association between household socioeconomic determinants and perception of water quality. Age, gender, and population group, level of education, income source, income, and province of residency, geographical settlement, and distance to a water source are among household variables studied. The perception of the household water quality is also examined in order to ascertain the level of satisfaction and discontent with the quality of households' main source of potable water. The analysis starts with a detailed description of the household socioeconomic characteristics, followed by cross tabulation and a chi-square statistical test to evaluate the association between socioeconomic variables and access to water. The lambda, Cramer's V, and phi tests were used to assess the strength of the association. Multivariate analysis was performed. A logistic regression analysis was used in this study to understand the household characteristics that influence access to water and perceptions of water quality**.**

4.2 Household Socioeconomic Characteristics

Table 4.1: Sample composition of the household heads' socioeconomic characteristics

HH Gender	Frequency	Percentage
Male	9482076	56.9
Female	7188778	43.1
Total	16670854	100.0
HH Age		
12-26	1230251	7.4
27-41	4176618	25.1

42-56	5827200	35.0
57-71	4173534	25.0
72+	1263249	7.6
Total	16670854	100.0
Population group		
Black/African	13830838	83.0
Coloured	1347174	8.1
Indian/Asian	315945	1.9
White	1176897	7.1
Total	16670854	100.0
Settlement type		
Formal urban	10757474	64.5
Traditional	5209894	31.3
Farms	703486	4.2
Total	16670854	100.0
HH monthly income		
No monthly income	31237	1.6
Low income	547930	28.2
Moderate income	535515	27.5
High income	830078	42.7
Total	1944760	100.0
Income source		
Salaries/wages/commission	8595595	53.3
Income from a business	1249680	7.8
Remittances	1518425	9.4
Pensions	383655	2.4
Grants (including old-age grants)	3998639	24.8
Sales of farming products and services	26697	0.2
Other income sources e.g. rental income, interest	204202	1.3
No income	140685	0.9
Total	16117579	100.0

HH level of education		
Primary school	2463122	15.0
College	10181168	61.9
Cert/Degree	1996583	12.1
Post-graduate degree	372224	2.3
No schooling	1428302	8.7
Total	16441399	100.0

Source: Computed from Stats SA 2018 GHS data

NB: Totals are not equal because do not know, refusal, not applicable and unspecified response were excluded before the analysis was performed.

Table 4.1 depicts the socioeconomic characteristics of the household head, percentage distribution and their totals. As indicated in Chapter Three, the unit of analysis for the study is the household head. One of the foci of the study is to understand the household determinants that hinders household from accessing water from an improved water source and how the level of access to water varies across South Africa national provinces and settlement areas (rural-urban areas). The first household characteristic in the table is the gender of the household head. The gender composition gives an indication of the proportion of the household heads who are male and female. The result from the table shows that household heads comprise approximately 57% male and 43% female household heads. This suggests that there are more male-headed households as compared to females in South Africa. This also shows that the majority of the household respondents in the survey are male, even though females are responsible for the collection and management of water for the household. Nevertheless, as seen in the literatures in Chapter Two, the male household head also plays a direct or indirect role in collecting water for the household. In most cases, they also provide the finances for purchasing water for household use.

The age of the household head is the second variable in Table 4.1 above. From the collected data, it can be seen that the age of the household head ranges from the age of 12 to 102. For the purpose of this study, the ages of the household head were grouped into five categories. The age proportions were 12-26 (7.4%), 27-41 (25.1%), 42-56 (35%), 57-71 (25%) and 72+ (7.6%). It is observed that household heads between the ages of 42 and 56 recorded the highest percentage and household heads. Age 12-26 and 72 and above have the lowest percentage; this suggests that in South Africa, more household heads are between the ages of 42-56, while only a few percentage of the household heads are between the ages of 12 and 26 and 72 and above. The household head population group follows the age composition. From the table above, it is evident that more household heads are Black/African (83%), followed by Coloured (8.1%), White (7.1%) and Indian/Asian (1.9%). This shows that in South Africa, the majority of the household heads are Black/African compared to Coloured, White, and Indian/Asian. Similarly, in terms of settlement area, 64.5% of the household heads reside in the formal urban areas, followed by traditional and farm settlements recorded as 31.3% and 4.2% respectively.

Another key household characteristic is the monthly income of the household head. From the data collected, some household heads did not specify their monthly income, even though Acts are provided to protect the individual. Before the data was analysed, household heads who did not specify their monthly income have been excluded from the analyses. This is performed by using a select cases ribbon provided by SPSS. The results show that the total number of the household heads who indicated their monthly income is 1944760 (100%), and furthermore, householders with no income (1.6%), R1-R1000 (4.7%), R1001-R3500 (15.8%), R3501-R8000 (24.9%), R8001-R16000 (22.7%) and >16000(30.2%). It is observed that household heads have different monthly incomes, the majority of the household heads earn over R16000 monthly, and only 1.6% of the household heads are without a monthly income. For the purpose of this study, the monthly income of household head are grouped into; no monthly income, low monthly income, moderate monthly income and high monthly income. Even though household heads stated their monthly income, the survey also asked the household what the source of their income is. Not all household heads specified the source of their income and household heads who did not state the source of their income have been excluded from this analysis. From Table 4.1, it is evident that the main sources of income for household heads are salaries/wages/commission (53.3%) and grants (including old-age grant) (24.8%). Less than 10% of the household heads stated that their income source is from business, remittances, pensions etc. as shown in Table 4.1.

The last household characteristics in Table 4.1 is the household head's highest level of education. The different levels of education are categorised into groups. Household heads who did not specify their highest level of education have been excluded from the analysis. The results show that most household head have college degrees (61.9%), followed by a primary degree (15%), a certificate/degree (12.1%), no schooling (8.7%) and a post graduate degree (2.3%). This is an indication that the highest level of education for most household heads in South Africa is a college degree and only a few percent of the household heads have obtained a post-graduate degree.

4.3 Level of Access to Potable Water in South Africa

The first objective of the study is to determine the proportion of the households with access to improved water sources, using the GHS 2018 data. However, in the data, there are several but similar sources of water available to households for consumption as shown in Chapter Three, and the availability of these sources enable households to meet their different domestic needs. The main sources of water for drinking in the household have been subdivided into three categories, namely: piped water in premises/yard, an improved water source and unimproved water source, using the 2015 JMP classification as indicated in the previous chapter. The results from the analysis show that, approximately 48% of the households in South Africa use piped water in premises, 43% use other improved water sources such as a communal tap, neighbour's tap and borehole on site etc., while 9% use water from an unimproved source, such as flowing water/stream/river and stagnant water/dam/pool etc. It is worth noting that in the questionnaire, household heads were asked to indicate if they use more than one available water sources to meet their drinking water needs and at least every surveyed household stated that they use one of the sources mentioned. Figure 4.1 below shows the percentage distribution of households' main source of potable water.

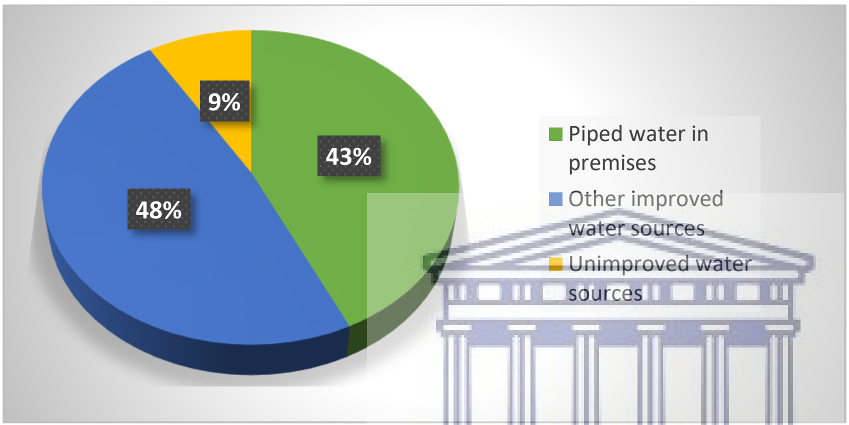


Figure 4.1: Percentage distribution of the main source of potable water.

4.3.1 Level of access to potable water across gender of the household head

The gender of the household head is one of the key variables in this study. Levels of access to potable water in terms of the gender of the household head were analysed using the main source of drinking water and sex of the household head, according to the 2018 GHS data. It can be seen in Figure 4.2 below that 45.7% of male-headed households have piped water in the premises, while 39.2% of female-headed households have access to piped water in the premises. 50.7% female household heads and 46.5% of male household heads use water from other improved water sources respectively and lastly, 10.1% of female-headed households used water from unimproved sources, compared to 7.9% of male-headed households. The results observed show that levels of access to water in terms of gender is uneven. While male-headed households have more access to piped water in the premises, more female-headed household have access to unimproved water sources. Figure 4.2 below depicts the percentage distribution of access to potable water by gender of the household head.

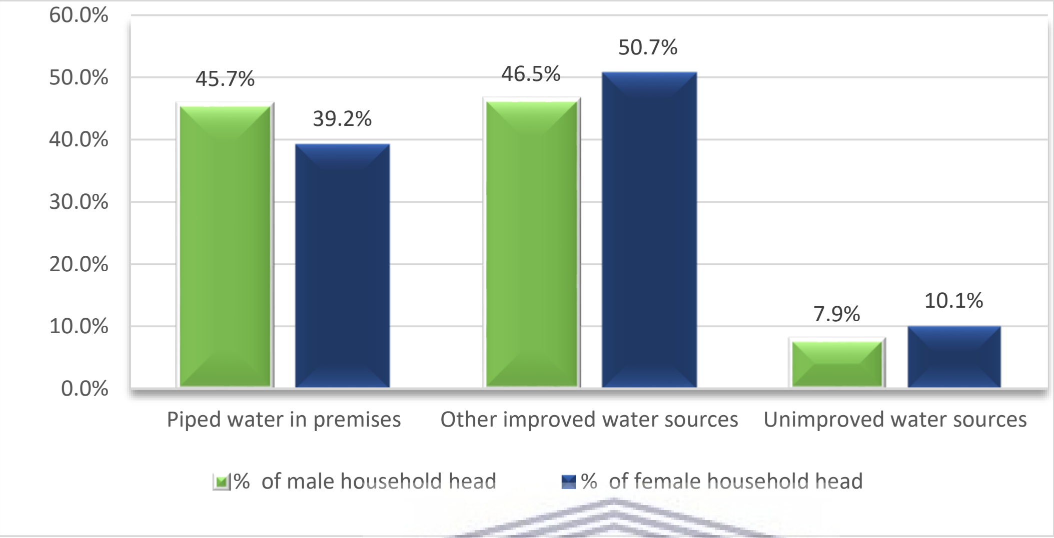


Figure 4.2: Percentage distribution of main source of water by gender of the household head.

To ascertain if there is an association between access to water and the gender of the household head, a chi-square test was performed. The results show that $\chi 2$ (2) = 77212.842, p = 0.000, which shows that at 2 degree of freedom, the chi-square value is 77212.842, which is the sum of the difference between the observed and expected categorical responses between two or more independent groups. The p value is the significant level. Therefore, since 0.000 is the p-value between access to water and gender of the household head is less than 0.05, which is the test statistic, it is an indication that it is significant and there is a significant relationship between access to water and the gender of the household head. The study therefore concludes that in the context of this study, it is likely that the gender of the household head influences access to potable water. The phi and Cramer's V, and lambda were used to measure the strength of the relationship between the two nominal variables; the results in Table 4.2 below shows that there is a weak relationship between access to water and gender of the household head.

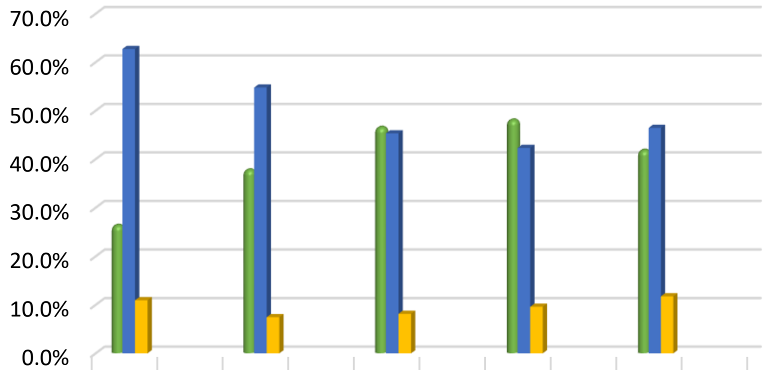
Table 4.2: Chi-square test for association between access to water and gender of the household head

Statistic	chi-square	lambda	phi	Cramer's V
Value	77212.842[a]	0.137	0.068	0.068
Sig	0.000	-	0.000	0.000

$\chi 2$ (2) = 77212.842, p = 0.000, 0 cells (0, 0%) have expected count less than 5. The minimum expected count is 633347, 2

4.3.2 Level of access to potable water across age of the household heads

To understand the level of access across the ages of the household heads, the main source of potable water was cross-tabulated with the ages of the household heads. As previously indicated, only those of age 12 and above were considered household heads. The results show access to piped water in the premises were for household heads aged 12-26 (24.4%), 27-41 (37.8 %), 42-56 (46.6 %), 57-71 (48.1 %), and 72+ (42.5%). It was observed that as the age of the household head increase from 12-71, access to piped water in the premises also increases, while from age 72 and above, a slight decrease of about 7% of access to piped water in the premises was noted. For access to other improved water sources, ages 12-26 and 27-41 have a higher access level of 62.7% and 54.8% respectively. Ages 42-56, 57-71 and 72+ access to other improved water sources were 45.3%, 42.3% and 46.4% respectively. The highest level of access to unimproved water source across household heads' ages was seen across the age 72+ (10.9%) and 12-26 (10.9%), while other age groups in this category recorded below a 10% level of access. The generation effect observed in this result is that the younger generation of the household heads (12-41) are more likely to access other improved water sources in South Africa. On the other hand, the older generation (42-102) are likely to have access to piped water in the premises. Figure 4.3 below shows the percentage distribution of access to water across household head age groups.



	12-26	27-41	42-56	57-71	72+
Piped water in premises	26.4%	37.8%	46.6%	48.1%	41.8%
Other improved water sources	62.7%	54.8%	45.3%	42.3%	46.4%
Unimproved water sources	10.9%	7.5%	8.1%	9.6%	11.7%

Figure 4.3: Percentage distribution of main source of water by age of the household head.

A chi-square statistical test was further used to measure the association between access to water and the age of the household heads. The results showed a p-value of 0.000. With the p value (0.000) less than the test statistic cut-off value of 0.05; the study concluded that there is a statistically significant relationship between access to piped water and the age of a household head. Furthermore, the lambda, phi and Cramer’s V were used to measure the strength of association between access to water and the age of the household head. The findings show a weak association. Table 4.3 below depicts the outcome of the chi-square test of association.

Table 4.3: Chi-square test for association between access to water and age of the household head

Statistic	chi-square	lambda	phi	Cramer's V
Value	313940.778[a]	0.016	0.137	0.097
Sig	0.000	0.000	0.000	0.000

$\chi2$ (8) = 313940.778, p = 0.000 cells (0, 0%) have expected count less than 5. The minimum expected count is 108387, 9.

4.3.3 Level of access to potable water across age and gender of the household head

To further understand the influence of age on access to water, the gender of the household head was used as a control variable. Observing the percentage distribution in Figure 4.4 below, the results show the following in term so of piped water in the premises for males within the different age groups: 12-26 (26.1%), 27-41 (39.4%), 42-56 (50 %), 57-71 (53 %), and 72+ (50.4%), while for the female age groups: 12-26 (26.8%), 27-41 (34.8%), 42-56 (42.1 %), 57-71 (42.8%) and 72+ (36.2%). It is observed that across each age group, more male-headed households have a high level of access to water, compares to the female-headed household. Across each age group, except for ages 12-26, the access to other improved water source is 6.4% and 59.4% for male- and female-headed households, respectively; it can be seen that access to other improved water sources is higher for female than male household heads. Similarly, as is evident in the findings for other improved water sources, more female household heads across each age group are seen to have access to water from unimproved water sources, compared to male household heads. The highest level of access to unimproved water can be seen among females between the ages of 12 and 26 and older females from age 72 and above. See Appendix 1 for a detailed table showing the distribution of main source of water by gender and age of the household head.

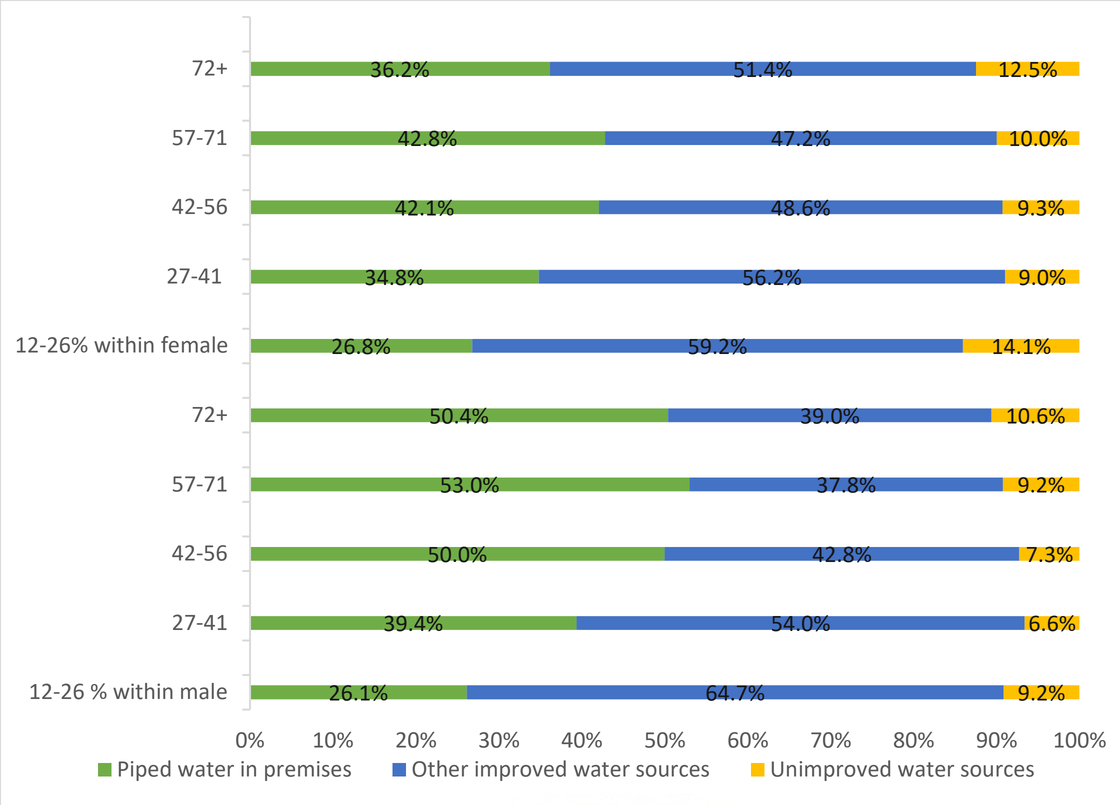


Figure 4.4: Percentage distribution of main source of water by age and gender of the household head.

A chi-square test for association was performed to ascertain the association between the main source of water and the age of the household head with respect to the gender of the household head. This is to show the relationship between age of the household head with respect to their gender and access to water. The test statistic cut-off value is 0.05. The results show that across each age group there is a significant relationship between gender (male and female) of the household head and access to water, given that level of significance is 0.00. The strength of the relationship between the age of the household head with respect to their gender and access to water was measured using lambda, phi and Cramer's V. The results show that there is a weak relationship/weak association for both males and females across differing age groups of the household head and access to water. Table 4.4 depicts the outcome of the chi-square test for association.

Table 4.4: Chi-square test for association between access to water and age of the household head

Male

Statistic	chi-square	lambda	phi	Cramer's V
Value	289949.594	0.060	0.175	0.124
Sig	0.000	0.000	0.000	0.000

Female

Statistic	chi-square	lambda	phi	Cramer's V
Value	74916.910	0.000	.102	0.072
Sig	0.000	0.000	0.000	.000

$\chi 2$ (8) = 289949.594, p = 0.000 α = 0.05, $\chi 2$ (8) = 74916.910, p = 0.000, α = 0.05.

4.3.4 Level of access to potable water across the population groups of the household heads

One of the specific objectives of the study is to understand the level of access to water across the different population groups in South Africa. Using the data as previously mentioned, the main source of potable water were cross tabulated with the population groups of the household heads. The results show that for piped water in the premises, Indian/Asian and White household heads have the highest level of access, i.e. 93.6% and 93% respectively, followed by Coloured household heads (80.4%) and Black/African (33.8%). It is clearly seen from the results that Black/African household heads have the lowest level of access to piped water in the premises. On the other hand, the results from the analysis show that Black/African household heads have the highest level of access to water from other improved water sources, followed by the Coloured, Indian/Asian and White population groups. For access to unimproved water sources, the following levels were recorded: Black/African (10.2%), White (3.2%), Coloured (1.1%) and Indian/Asia (0.7%). Contrary to the popular belief that White households have better access to water than any other population, the results show that the Indian/Asian group have better levels of access than other population groups. Figure 4.5 below depicts the percentage distribution of the main source of water by population group of the household head.

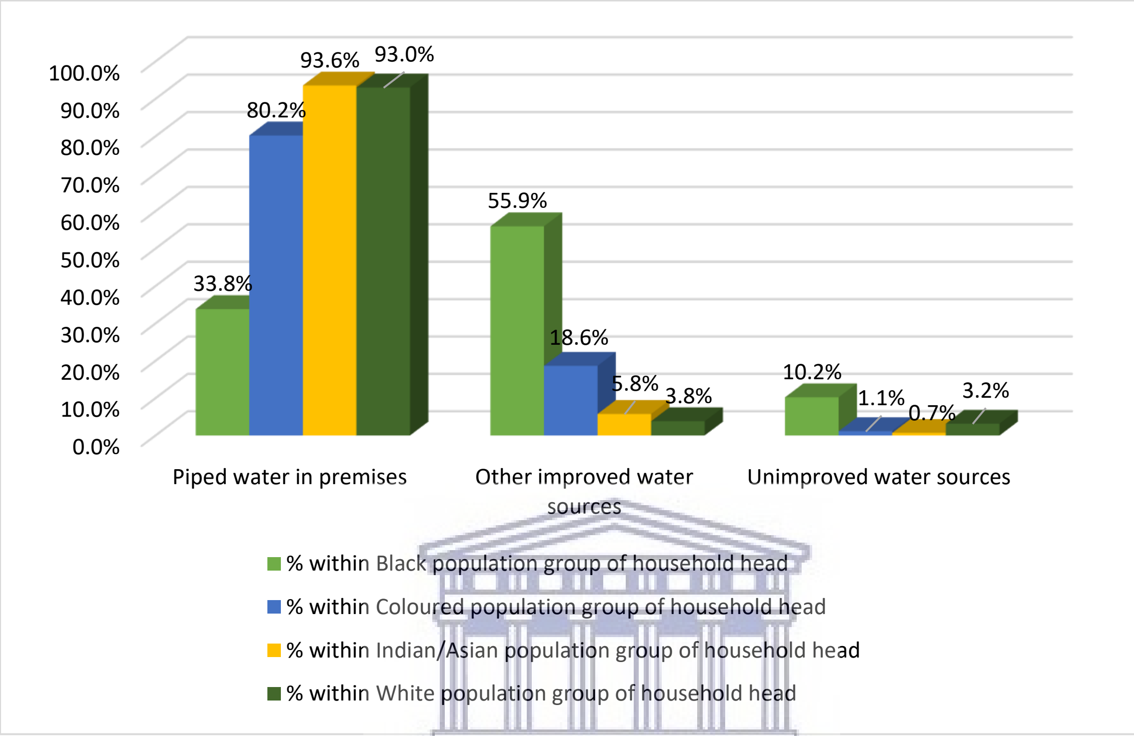


Figure 4.5: Percentage distribution of main source of water by population group of the household head.

A chi-square test for association is used to establish the association between the main source of potable water and the population group of the household head. The chi-square result shows that there is a statistically significant association between the main source of water and the population group of the household head. This is because the output showed a p-value of 0.000 between access to water and the population group of the household head, lower than the test statistic 0.005. Therefore, there is enough statistical evidence that there is a significant association between access to water and the population group of the household head. A phi test is used to measure the strength of the association between access to water and the population group of the household head shows. The output shows that at a p-value of 0. 408, there is the statistical significantly strong relationship between access to water and the population group of the household head. Table 4.5 below shows the result of the chi-square test for an association between access to water and the population group of the household head.

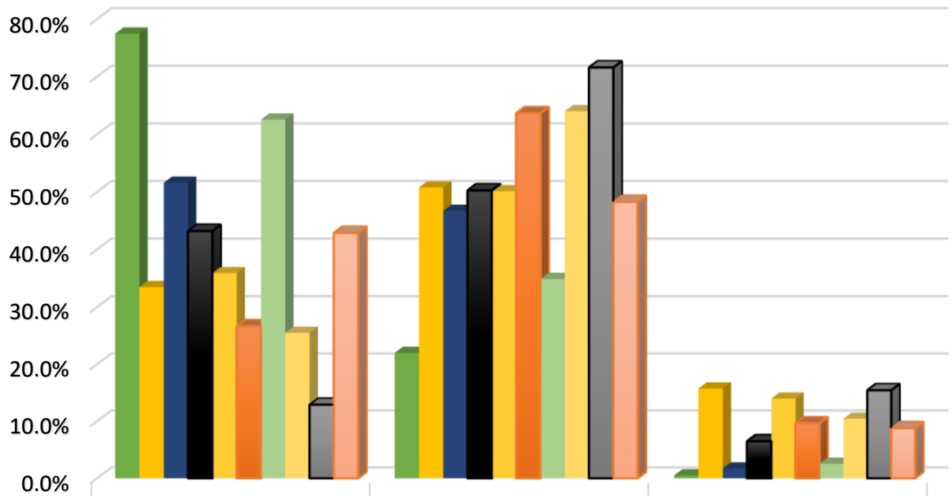
Table 4.5: Chi-square test for association between access to water and the population group of the household head

Statistic	chi-square	lambda	phi	Cramer's V
Value	2781437.849[a]	0.188	0.408	0.289
Sig	0.000	0.000	0.000	0.000

$\chi 2$ (6) = 2781437.849[a], p = 0.000 N of Valid Cases 16670854, $\alpha = 0.05$

4.3.5 Level of access to potable water and the provinces of the household heads

The aim of this analysis is to understand if access to water varies across national provinces of the household heads. The results show that access to piped water in the premises is very high in province such as Western Cape (77.5%), Gauteng (62.6%) and Northern Cape (51.6%) and the provinces with lower levels of access to piped water in the premises are North West (26.7%), Mpumalanga (25.5%) and Limpopo (12.9%). On the other hand, the province with the highest level of access to other improved water sources are Limpopo (71.6%), Mpumalanga (64%) and North West (63.6%). For level of access to unimproved water source, provinces such as the Eastern Cape (15.8), KwaZulu-Natal (14.0) and Limpopo (15.5) have the highest percentage of the household heads who access water from unimproved water sources. What is observed from this result is that access to water differs from one province to another. Households living in provinces that are more developed have better access to piped water in the premises, and other less developed provinces have higher levels of access to water from other improved sources and unimproved water sources. Figure 4.6 below displays the level of access to water across province.



	Piped water in premises	Other improved water sources	Unimproved water sources
% within Western Cape	77.5%	22.0%	0.5%
% within Eastern Cape	33.5%	50.8%	15.8%
% within Northern Cape	51.6%	46.7%	1.7%
% within Free State	43.2%	50.3%	6.5%
% within KwaZulu-Natal	35.9%	50.1%	14.0%
% within North West	26.7%	63.6%	9.7%
% within Gauteng	62.6%	34.9%	2.5%
% within Mpumalange	25.5%	64.0%	10.4%
% within Limpopo	12.9%	71.6%	15.5%
% within South Africa	42.9%	48.3%	8.8%

Figure 4.6: Percentage distribution of main source of water by province of the household head.

Given that Figure 4.6 above shows that there is an unequal distribution of access to water across national provinces, it is important to examine if there is an association between access to water and the household heads' province of residence. The chi-square test for association was used to examine the relationship between access to water and provinces of the household head. The results show there is statistical association between household access to water and the province. The P-value (0.000) is less than the test statistic of 0.05. This shows that is enough evidence to prove there is a relationship between access to water and provinces of the household heads. The lambda, phi and Cramer's V test for measurement of strength of association are displayed in Table 4.6 below. The output of the phi test shows that a very strong association between a household's main source of potable water and province. This suggests that the province is a strong and significant socioeconomic determinant that can be used to predict access to potable water in South Africa. Table 4.6 below shows the chi-square test results of association.

Table 4.6: Chi-square test for association between access to water and province

Statistic	chi-square	lambda	phi	Cramer's V
Value	2854805.286	0.108	0.414	0.293
Sig	0.000	0.000	0.000	0.000

$\chi 2$ (16) = 2854805.286, p = 0.000, α=0.05

4.3.6 Level of access to potable water and household heads' geographical locations

This aim of this section is to understand the influence of the geographical location of a household head on their access to potable water. The variable used is the main source of potable water for household and the geographical settlement of the household head. The results from the analysis conducted show that 62.3% of the households within formal urban settlements, 25.3% of the households in farm settlement areas and 5.2% of the households in traditional settlement areas have access to piped water in the premises. Looking at other improved water sources, 74.1% of the households within traditional settlement areas, 51.3% of the households in farm settlement areas and 35.6% of the households in formal urban settlements access water from other improved water sources. Furthermore, in terms of access to unimproved water sources, 2.1% of the households in formal urban settlements, 20.6% of the households in traditional settlements and 23.4% of the households in farm settlement areas have access to unimproved water. From the observations, it can be deduced that household heads living in formal urban settlements have better access to potable water that is, piped water in the premises, and other improved sources of water. Household heads living in traditional settlement areas have access to other improved water sources, but not piped water in the premises and the lowest level of access to water in the premises is found among households living in farm areas. More of the latter households tend to access water from unimproved water sources. Figure 4.7 below shows the percentage distribution of access to improved water by a household head's geographical location.

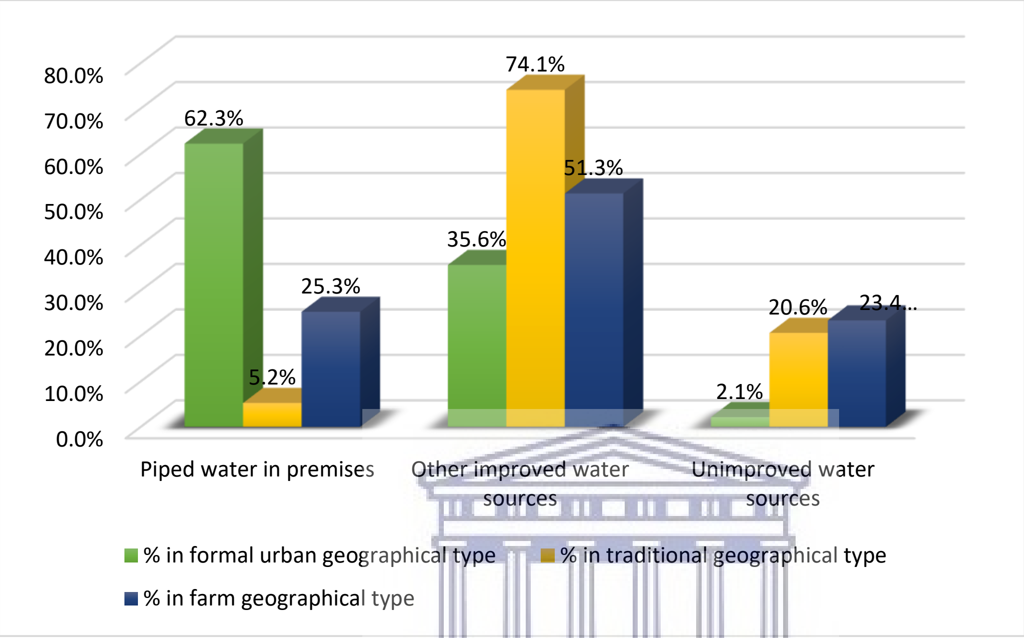


Figure 4.7: Percentage distribution of main source of water by household heads' geographical location.

Although Figure 4.7 above shows that the percentage distribution of access to water across the geographical settlement of the household head, a chi-square test for association was used to examine the if there is a relationship between access to water and the geographical location of the household head. The results as shown in Table 4.7 below suggest that there is statistical association between households' access to water and the household heads' geographical location. This deduction was made because the p-value 0.00 is lower than test statistics 0.05. The results for lambda show that there is a moderate association between households' main source of water and the geographical location of the household head; the phi and Cramer's V show a very strong association between access to water and geographical location of the household head. This implies that the geographical settlement area of the household head is a good socioeconomic determinant used in prediction of the level of access to potable water.

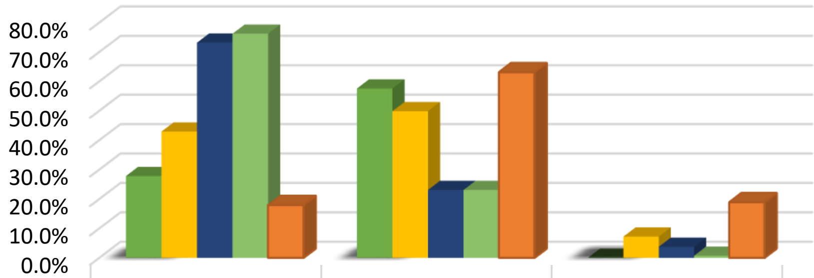
Table 4.7: Chi-square test for association between access to water and geographical location of the household head

Statistic	chi-square	lambda	phi	Cramer's V
Value	5338730.657	0.258	0.566	0.400
Sig	0.000	0.000	0.000	0.000

$\chi2$ (4) = 5338730.657, p = 0.000, α = 0.05

4.3.7 Level of access to potable water and household heads' highest level of education

Vertically, it can be seen that the highest level of access to piped water was between household heads with a postgraduate degree and a certificate/degree with levels of 76.2% and 73.2% access, respectively. Of the households with no schooling, 17.9% have access to piped water in the premises. This suggests that having access to piped water in the premises is determined by the household head's level of education. Also, those with access to other improved water source were recorded at 63.1% and 57.6% were households with no education or a primary school certificate, having the highest level of access in this category. It is obvious from the results that household heads with a postgraduate degree and certificate/degree have lower levels of access to other improved water sources. What is also obvious from the results is that household heads with no education have a greater tendency to access water from unimproved water sources. In general, the results show that the level of access to piped water in the premises increases with the level of education, while the level of access to other improved water sources does not increase with an increase in the level of education of the household head. Figure 4.8 below depicts the percentage distribution of access to potable water across household heads' highest level of education**.**



	Piped water in premises	Other improved water sources	Unimproved water sources
Primary school	27.8%	57.6%	0.0%
College	42.9%	49.9%	7.2%
Cert/Degree	73.2%	23.1%	3.8%
Post graduate degree	76.2%	23.1%	0.7%
No schooling	17.9%	63.1%	18.9%

Figure 4.8:% distribution of main source of water by household heads' highest level of education.

To understand the association between water and household heads' highest level of education, the chi-square test for association was conducted. The results from the chi-square test confirms that there is a statistically significant association between the level of education and access to water, since the p-value 0.00 is lower than test statistic 0.05. We can therefore conclude that household heads' level of education influences access to potable water. The phi and Cramer's V results indicate that there is a moderate significant association between the two variables under study. Also, the lambda test indicates that there is a weak association between the level of education and access to water. All the chi-square test results seem to be significant, however, the strength of association varies across each test. Table 4.8 below displays the chi-square test for association between access to water and household heads' highest level of education

Table 4.8: Chi-square test for association between access to water and household heads' highest level of education

Statistic	chi-square	lambda	phi	Cramer's V
Value	1663420.814	.081	.318	.225
Sig	.000	.000	.000	.000

$\chi 2$ (8) = 1663420.814, p = 0.000, α = 0.05.

4.3.8 Level of access to potable water and household heads' income sources

Household heads' sources of income is a very important determinant that is used to examine the level of the households' access to potable water. According to 2018 GHS data, the income source of the household head ranges from salaries/wages/commissions to other income sources e.g., rental income, interest. There are also household heads without a source of income. Therefore, this study aims to understand how income source influences access to potable water. From the results, it can be seen that 77.3% of the households with a pension have the highest level of access to piped water in the premises and this is followed by 61.9% of the households with other income sources, such as rental income or interest. Household heads with grants (including old-age grants) and no income source have the lowest level of access to piped water in the premises, i.e., 27.3% and 21.1% respectively. In terms of other improved water sources, the highest level of access is found among household heads with no source of income (70.5%), remittances (63.6%) and grants (57.2%), while other household income sources have levels of below 50% for the same category. The results also show that 15.5% of household heads receiving grants and 11.4% of the household heads with remittances as an income source have the highest level of access to unimproved water sources. According to the analysis, having income sources increases access to piped water in the premises. On the other hand, not having an income source does not necessarily imply that the household will only have access to an unimproved water source; those without an income source can have access to other improved water sources such as communal taps and neighbour's taps. The totals and percentage distribution of access to water and household heads' income source are displayed in Table 4.9.

Table 4.9: Totals and percentage distribution of access to water by household heads' income sources

Income Sources	HH Main Source of water			Total
	Piped water in premises	Other improved water sources	Unimproved water sources	
Salaries/wages/commission	4318086	3792061	485448	8595595
	50.2%	44.1%	5.6%	100.0%
Income from a business	625574	531218	92887	1249679
	50.1%	42.5%	7.4%	100.0%
Remittance	379998	965165	173262	1518425
	25.0%	63.6%	11.4%	100.0%
Pension	296746	69324	17585	383655
	77.3%	18.1%	4.6%	100.0%
Grants (including old-age grants)	1092861	2287027	618751	3998639
	27.3%	57.2%	15.5%	100.0%
Sales of farming products and services	11231	13199	2268	26698
	42.1%	49.4%	8.5%	100.0%
Other income sources e.g. rental income, interest	126477	67648	10076	204201
	61.9%	33.1%	4.9%	100.0%
No income	29642	99229	11814	140685
	21.1%	70.5%	8.4%	100.0%
Total	6880615	7824871	1412091	16117577
	42.7%	48.5%	8.8%	100.0%

Source: Computed from Stats SA 2018 GHS data.

To understand the association between access to water and household head income sources, the chi-square test for association was performed. The result from the chi-square test confirms that there is statistically significant association between income sources and access to water because the p-value 0.000 is less than the test statistic 0.05. The study therefore, concludes that household heads' income sources influence access to potable water. The phi, Cramer's V, lambda, and chi-square test results indicate that there is significant association between income sources and access to water, although, the phi test indicates that the association between access to water and household heads' income sources is moderate. The Cramer's V and lambda test showed weak association between income sources and access to water. Table 4.10 below displays the chi-square test for association between access to water and householder income sources.

Table 4.10: Chi-square test for association between access to water and householders' income sources

Statistic	chi-square	lambda	phi	Cramer's V
Value	67367.116	0.066	0.273	0.193
Sig	0.000	0.000	0.000	0.000

$\chi2$ (14) = 1203789.629, p = 0.000, α = 0.05.

4.3.9 Level of access to potable water and household heads' monthly income

In countries where water is paid for, most especially in South Africa, household income can be used to determine the levels of and households' source of water. As previously stated, this study conceptualises household monthly income into four categories. These categories were cross tabulated with households' sources of potable water and the result from the analysis shows that household heads with a high income (82.3%) and moderate income (58.6%) have high access levels to piped water in the premises while no income and low income earners have 33.4% and 32.9% access to piped water in the premises, respectively. Household heads with no income and low income have the highest level of access to water from other improved water sources, i.e., 60.8% and 60.2% respectively. For unimproved water source, household heads with no income (5.8%) and low income (6.8%) have the highest level of access compared to household heads with a moderate and high income. This implies that household heads with monthly income have access to piped water in the premises and the higher the income the higher the chances of the household having piped water in the premises. On the other hand, household heads with no income can have access to other improved water sources but the chances of them accessing unimproved water sources increases. Table 4.11 below shows the totals and percentage distribution of access to water by household heads' monthly income.

Table 4.11: Totals and percentage distribution of access to water by household heads' monthly income

Monthly Income	Piped water in premises	Other improved water sources	Unimproved water sources	Total
No monthly income	10445	18980	1812	31237
	33.4%	60.8%	5.8%	100.0%
Low income	180507	329994	37429	547930
	32.9%	60.2%	6.8%	100.0%
Moderate income	313748	205953	15814	535515
	58.6%	38.5%	3.0%	100.0%
High income	683345	119657	27075	830077
	82.3%	14.4%	3.3%	100.0%
Total	1188045	674584	82130	1944759
	61.1%	34.7%	4.2%	100.0%

Source: Computed from Stats SA 2018 GHS data

To examine the association between household heads' level of income and access to water in South Africa, the study employed the chi-square test statistic of association. The chi-square test output indicates a p-value of 0.000, which is less than the test statistic value of 0.05. This implies that there is statistical evidence to show that there is significant association between householders' level of the household monthly income and access to potable water. This shows again that level of income can increase the chances of having access to potable water. To measure the strength of the association, the study employed lambda, phi and Cramer's V tests. The findings reveal strong significant association between access to water and level of income in South Africa. Table 4.12 shows the output of the chi-square test for association between access to water and householders' monthly income.

Table 4.12: Chi-square test for association between access to water and householder Monthly Income

Statistic	chi-square	lambda	phi	Cramer's V
Value	359332.019	.202	.430	.304
Sig	.000	.000	.000	.000

$\chi 2$ (6) = 359332.019, p = 0.000, α = 0.05.

4.4 Distance travelled to main source of water

With people having to travel outside their homes to access water, the study finds it important to evaluate the influence of the distance necessary to travel on access to water. As indicated in the literature in Chapter Two, women and girls are mainly responsible for collecting water for the household. Therefore, using distance to a water source as a proxy for access to water, this section examines how it varies across gender and population group. It is worth noting that a household is considered to have access to water if its main source of potable water is within 200m of the dwelling unit (Stats SA, 2018). Furthermore, the distance travelled to a water source was examined across the various sources of water. This so because, people might travel longer distances to collect water from improved water sources and those free from contamination.

4.4.1 Distance of water source from the dwelling and gender of the household head

Having analysed the distance of a water source from the dwelling and gender of the household head, the results show that 52.7% male-headed households walk less than 200m and 47.3% female-headed households walk less than 200m to access water. Using the definition of access to potable water with regard to distance travelled, this implies that male-headed households have better access to water than female-headed households. On the other hand, for a distance of more than 1 kilometre travel, more males are seen to have better level of access to unimproved water than females. Using the total percentages of distance travelled to water by gender of the household head, the results from the analysis further illustrates that more female-headed households travel more than a kilometre to collect water, mainly from an unimproved source, compared to male-headed households. Table 4.13 below illustrates the totals and percentage distribution of distance to water source and gender of the household head.

Table 4.13: Totals and percentage distribution of distance to water source and gender of the household head

Distance of water source from the dwelling	Gender of the household head		Total
	Male	Female	
Less than 200 metres	1041577	936718	1978295
	52.7%	47.3%	100.0%
201-500 metres	473125	584013	1057138
	44.8%	55.2%	100.0%
501-1 kilometre	162910	238993	401903
	40.5%	59.5%	100.0%
More than 1 kilometre	96655	76970	173625
	55.7%	44.3%	100.0%
Total	1774267	1836694	3610961
	49.1%	50.9%	100.0%

Source: Computed from Stats SA 2018 GHS data.

To examine the association between the distance of a water source from the dwelling and gender of the household head, the study employed the chi-square test statistic of association. The chi-square test output indicates a p-value of 0.000 and this is less than the test statistic value of 0.05, which shows that there is statistical evidence to show that there is significant association between the gender of the householder and the distance of a water source from the dwelling. To measure the strength of the association, the study further employed lambda, phi and Cramer's V tests. The findings show a weak association between the distance of a water source from the dwelling and the gender of the household head in South Africa. Table 4.14 below shows the output of the chi-square test for association between the distance of a water source from the dwelling and the gender of the household head.

Table 4.14: Chi-square test for association between the distance of a water source from the dwelling and the gender of the household head

Statistic	chi-square	lambda	phi	Cramer's V
Value	32754.960	.037	.095	.095
Sig	.000	.000	.000	.000

$\chi 2$ (3) = 32754.960, p = 0.000, α = 0.05.

4.4.2 Distance travelled to water source by gender and the source of water

Table 4.15 below shows the totals and percentage distribution of the distance travelled to a water source by gender and the source of water. The results suggest that most male household heads' travel distance is less than 200m to collect water from an unimproved water source, compared to 45.1% of females who travel a distance of less than 200m to collect unimproved water. On the other hand, more female household heads are seen to travel a distance of between 201m to 1km to collect unimproved water. For improved water sources, 51.9% of male-headed households walk a distance of less than 200m to collect water from an improved water source, relative to female household heads who travel a distance of less than 200m to collect improved water. Similar to unimproved water sources, more females are also seen to walk a distance of over 200m to collect water from an improved source. The result suggests that females travel long distances to collect water either from an improved or unimproved water source. The observed result also shows that a distance of further than 200m can also be travelled to source improved water. This situation where households walk longer distances is more applicable to households in the rural and marginalised areas where water facilities are situated at the centre of the town and household members have to travel longer distances to collect water for the household.

Table 4.15: Totals and percentage distribution of distance to water source and gender of the household head and source of water

Source of water	Distance travelled to water source	Gender		Total
		Male	Female	
Unimproved source	Less than 200 metres	282121	232182	514303
		54.9%	45.1%	100.0%
	201-500 metres	186184	225760	411944
		45.2%	54.8%	100.0%
	501-1 kilometre	106311	139637	245948
		43.2%	56.8%	100.0%
	More than 1 kilometre	75459	62607	138066
		54.7%	45.3%	100.0%
	Total	650075	660186	1310261
		49.6%	50.4%	100.0%
Improved source	Less than 200 metres	759456	704536	1463992
		51.9%	48.1%	100.0%
	201-500 metres	286941	358254	645195
		44.5%	55.5%	100.0%
	501-1 kilometre	56599	99356	155955
		36.3%	63.7%	100.0%
	More than 1 kilometre	21196	14363	35559
		59.6%	40.4%	100.0%
	Total	1124192	1176509	2300701

		48.9%	51.1%	100.0%

4.4.3 Distance of water source from the dwelling by population group and gender of the household head

Using distance travelled to a water source as a proxy for access to water, the study examined the distance travelled to a water source across the population groups of the household heads. The results show that only 54.3% of Black/African household heads travel less than 200m to collect improved water, compared to White (68%), Coloured (83.3%), and Indian/Asian (100%). This implies that Black/African households have the least access to potable water with regard to the distance travelled from the dwelling to the water source. More Black/African household heads (29.8%) travel between 201m to 500m to collect water, compared to Coloured (4.8%) and White (4.3%). A distance of over 501m to 1km is travelled by 11.2% and 13.9% of Black/African and White householders respectively, to source for water. For distance greater than 1km, 13.7% of Black/African, 4.7% of Coloured and 9.2% of White travel this distance to collect water for the household. See Appendix 2 for detailed results.

4.5 Perception of Water Quality

Households have varying opinions on the quality of their main source of potable water. Most households use the physical characteristics of water, such as taste, colour, and smell, to determine the quality of water they consume. Nonetheless, the perceptions of water quality can be influenced by a number of the households' socioeconomic determinants. According to Stats SA (2018), there has been a decline in the level of satisfaction among households who previously felt their water was clean, clear, had a good taste and was free from a bad smell. Consequently, the level of dissatisfaction among households who felt that their water was not clean, clear, did not have a good taste, or was not free of bad smells has increased (Stats SA, 2018). As a result, the study examines how South African households perceive the quality of the water they drink. Using physical properties of water as an estimation parameter, the study also examines if some household socioeconomic determinants influence households; perception of drinking water. The following sections show household perceptions of the quality of water they drink across different household socioeconomic determinants.

4.5.1 Perceptions of water quality across households' main source of potable water

The main source of water available to households was examined in term of households' perceptions of water quality (water safety, taste, clarity, and odour). The aim is to investigate how households perceive the water from each of the water sources. The observed results show that over 40% of households perceived piped water in the premises as safe to drink; tastes good, is free from bad smells and clear. Regarding piped water on site, less than 30% perceived that this source of water is safe to drink, tastes good, is clear and is free from bad smells. What was also observed is that below 40% and 30% also indicated that piped water in the premises and piped water on site, respectively, is not safe to drink, tastes bad, has a bad smell and is discoloured. For the other water sources, 15% indicate that the water source is safe to drink, tastes good, is free of bad smells and clear, while below 5% noted that the other sources of water are not safe to drink, taste bad, and have a bad smell and bad colour. The results further show the most accessible water source to a household is piped water in the premises and piped water on-site. See Appendix 3 for detailed results.

4.5.2 Households' perceptions with regard to the quality of the water they drink, by province

The study cross tabulated household perception (safety, taste, odour, and clarity) across national provinces to determine how South African households perceived their main source of potable water in terms of the physical qualities of water. The results reveal that the level of perception varies by province. Limpopo (97.8 %), Gauteng (97.7 %), North West (92.8 %), and Western Cape (92 8 %) had the highest level of satisfaction with regard to the safety of the households' main source of potable water, while the other provinces had levels of safety perception that were higher than 80 %. On the other hand, significant levels of dissatisfaction with the safety of the households' main source of potable water were observed in some provinces, such as the Northern Cape (13.9 %), the Eastern Cape (13.8%), Mpumalanga (12.8%), and Free State (10.1%).

Taste perception was also examined across provinces, with the results indicating that more households in provinces such as Gauteng, Limpopo, Free State, and Western Cape believed that the taste of their main source of potable water is good. Each province had a taste perception level of 80% and above respectively. On the other hand, significant dissatisfaction with the taste of the household potable water was observed in the Eastern Cape (15.6 %), Northern Cape (13.9 %), Mpumalanga (13.2 %), and North West (10.7 %) provinces. Household heads were asked about how they perceived the smell of their main source of potable water;' more than 90% of the households in almost all provinces stated that their main source of drinking water smelled good. Nonetheless, 10.8 % in the Northern Cape and Free State indicated that their main source of potable water smelled bad.

Furthermore, while some households in each province were satisfied with the colour of their main source of potable water, Free State (14.1 %), Northern Cape (13.7 %), Mpumalanga (11.5 %), and the Eastern Cape (11.5 %) were not satisfied with the quality of the household's main source of potable water. Having observed the perception of water quality in each province, it is worth mentioning that, while the level of perception varies by province, the level of perception of water quality in South Africa is considerable high. Table 4.16 depicts the perception of water quality across provinces.

Table 4.16: Perception of water quality across household head province of residence

Province	Safe to drink		Taste of water		Smell of water		Water Clarity	
	Safe to drink	Not safe to drink	Tastes good	Does not taste good	Smells good	Has a bad smell	Clear	Not clear
Western Cape	1504812	130580	1496495	135993	1523265	110242	1527815	109163
	92.0%	8.0%	91.7%	8.3%	93.3%	6.7%	93.3%	6.7%
Eastern Cape	1969070	316513	1925446	354703	2055273	218360	2021199	260685
	86.2%	13.8%	84.4%	15.6%	90.4%	9.6%	88.6%	11.4%
Northern Cape	645309	104298	645702	103905	667858	80530	647112	102495
	86.1%	13.9%	86.1%	13.9%	89.2%	10.8%	86.3%	13.7%
Free State	871419	98311	886996	83764	865350	104550	832284	136243
	89.9%	10.1%	91.4%	8.6%	89.2%	10.8%	85.9%	14.1%
KwaZulu-Natal	2444706	213392	2455611	191742	2477361	173940	2455879	193596
	92.0%	8.0%	92.8%	7.2%	93.4%	6.6%	92.7%	7.3%
North West	1044777	81623	1004879	119831	1045602	74581	1012554	111130
	92.8%	7.2%	89.3%	10.7%	93.3%	6.7%	90.1%	9.9%
Gauteng	3792425	91499	3767050	114968	3762353	108120	3770729	105014
	97.6%	2.4%	97.0%	3.0%	97.2%	2.8%	97.3%	2.7%
Mpuma-langa	1217203	178230	1204737	182751	1254486	137072	1232654	159860
	87.2%	12.8%	86.8%	13.2%	90.1%	9.9%	88.5%	11.5%
Limpopo	1864398	42337	1755732	148394	1773803	127507	1856268	53448
	97.8%	2.2%	92.2%	7.8%	93.3%	6.7%	97.2%	2.8%
South Africa	15354119	1256783	15142648	1436051	15425351	1134902	15356494	1231634
	92.4%	7.6%	91.3%	8.7%	93.1%	6.9%	92.6%	7.4%

Source: Computed from Stats SA 2018 GHS data.

4.5.3 Water quality perceptions by metropolitan/geographical area

Households' perceptions of water quality were studied across the geographical areas of residence. According to the 2018 GHS statistics, geographical areas are divided into two types: metro and non-metro. Looking at the results horizontally, it is observed that 92.2% of metro area dwellers indicated that the household's main source of water was safe to drink, 91.4 % indicated main source of drinking water tasted good, 93.0 % indicate that their main source of drinking water smelled good and 92.3 % indicated that their main source of drinking water was clear. Across the metro areas, household heads also indicated dissatisfaction with the household's main source of potable water, as follows: water not safe to drink (7.8 %), water taste was not good (8.6 %), water smell was bad (7.0 %) and water was not clear (7.7 %). Similarly, in non-metro areas, more than 90% of the households reported that their main source of water was safe to drink, the taste was good, the smell was good and the water was colourless. Likewise, in the non-metro area, less than 10% of the households said that their major source of drinking water was unsafe, cloudy, and had a bad taste and smell. According to the findings, household heads in South Africa's metropolitan areas have a high perception of their households' potable water. Table 4.17 presents household perceptions of drinking water by geographical areas.

Table 4.17: Totals and percentage distribution of the household perception of water quality by geographical area

Geogr.	Safe to drink		Taste		Smell		Clear	
	Yes	No	Yes	No	Yes	No	Yes	No
Metro	6869800	580437	6793511	642435	6911537	517437	6866345	569016
	92.2%	7.8%	91.4%	8.6%	93.0%	7.0%	92.3%	7.7%
Non-Metro	8484320	676347	8349136	793617	8513813	617464	8490150	662618
	92.6%	7.4%	91.3%	8.7%	93.2%	6.8%	92.8%	7.2%
Total	15354120	1256784	15142647	1436052	15425350	1134901	15356495	1231634

	92.4%	7.6%	91.3%	8.7%	93.1%	6.9%	92.6%	7.4%

Source: Computed from Stats SA 2018 GHS data.

4.5.4 Perceptions of water quality by age of the household head

The study examined perception of water quality across the age of the household head in order to understand if age influences households' perceptions of water quality. The organoleptic properties of water were cross tabulated across the age of the household head. The observed results show that, household heads aged 12-26 (93.4 %) indicated that their household's main source of potable water was safe to drink, 91.7% indicated that their main source of water tasted is good, 94.5 % noted their main source of water smelled is good, and 93.2% indicated that their main source of water was free of mud. For household heads aged 12-26, less than 10% perceived that their household's main source of water was not safe, tasted bad, smelled bad and was discoloured. The perception of water of quality for household heads aged 27-41 was as follows: safe to drink (93.2%), tasted good (92.4%), smelled good (93.9%) and clear (93.2%). For household heads age 27-41, less than 10% perceived that their household's main source of water was not safe, tasted bad, smelled bad and was discoloured. The results for all other household head age groups household head age 12-26 and 27- 41 follow a similar pattern to household heads aged 12-26 and 27-41 (see Table 4.18). Perceptions of water quality across household heads' age are shown in Table 4.18 below.

Table 4.18: Totals and percentage distribution of the household perception of water quality by age

HH age group	Safe to drink		Taste		Smell		Clear	
	Yes	No	Yes	No	Yes	No	Yes	No
12-26	1145383	80332	1120237	100849	1151394	69093	1140936	83573
	93.4%	6.6%	91.7%	8.3%	94.3%	5.7%	93.2%	6.8%
27-41	3870074	281501	3838335	314975	3897371	254688	3870006	283995

	93.2%	6.8%	92.4%	7.6%	93.9%	6.1%	93.2%	6.8%
42-56	5381371	430563	5302533	490804	5389023	391519	5388596	408674
	92.6%	7.4%	91.5%	8.5%	93.2%	6.8%	93.0%	7.0%
57-71	3807364	354234	3746593	404454	3830769	319564	3806953	348573
	91.5%	8.5%	90.3%	9.7%	92.3%	7.7%	91.6%	8.4%
72+	1149928	110154	1134949	124969	1156794	100037	1150005	106819
	91.3%	8.7%	90.1%	9.9%	92.0%	8.0%	91.5%	8.5%
Total	15354120	1256784	15142647	1436051	15425351	1134901	15356496	1231634
	92.4%	7.6%	91.3%	8.7%	93.1%	6.9%	92.6%	7.4%

Source: Computed from Stats SA 2018 GHS data.

4.5.5 Households' perceptions of water quality by income group

Since household income is known to have a substantial influence on access to potable water, this study examined perception of water quality across household income to see if it affects how households perceived the quality of their drinking water. Looking at the percentages, the results indicate that the households are significantly satisfied with the quality of their main source of potable water. However, while focusing on households' levels dissatisfaction with the quality of their main source of potable water, the results show that 9.9% and 7.3% of the household heads with no income perceived that their household's main source of potable water was not clear and the taste of the water was not good. For household heads with low income, the highest level of dissatisfaction with the quality of water quality is about taste and colour of water. Of this group, 7.3% and 6.3% indicated that their main source of drinking water tasted bad and was discoloured. Moderate-income household heads had almost the same level of dissatisfaction with the water quality, the levels being: unsafe (6. 0%), bad taste (6.4%), bad smell (5.4%) and not clear (6.3%). High-income householders evinced the least dissatisfaction, it was mainly about the smell, and clarity of their main source of water; 5.2% and 4.7% indicated that their main source of water was not clear and smells bad. From the result, it was observed that households with no income and low income are more concerned about the clarity of their water and smell; this could be because their main source of potable is generally from unimproved water sources and other improved water that is not piped water in the premises. Household heads with high and moderate income are most concerned about safety, taste, and colour of their water. This could also be because their water source is mainly piped water in the premises and other improved water source. Table 4.19 shows the totals and distribution of the households' perceptions of water quality across monthly income.

Table 4.19: Totals and percentage distribution of the household water quality perception by monthly income

Monthly Income	Safe to drink		Taste		Smell		Clear	
	Yes	No	Yes	No	Yes	No	Yes	No
No income	30551	686	27693	2174	28269	2174	27436	3007
	97.8%	2.2%	92.7%	7.3%	92.9%	7.1%	90.1%	9.9%
Low income	520213	24912	507062	39706	515305	29808	512277	34491
	95.4%	4.6%	92.7%	7.3%	94.5%	5.5%	93.7%	6.3%
Moderate income	502384	31886	497114	34158	503414	28872	500319	32817
	94.0%	6.0%	93.6%	6.4%	94.6%	5.4%	93.8%	6.2%
High income	766474	59822	765515	59933	787266	38663	781472	43117
	92.8%	7.2%	92.7%	7.3%	95.3%	4.7%	94.8%	5.2%

Source: Computed from Stats SA 2018 GHS data.

4.6 Average Distance Travelled to Water Source

The average distance travelled to collect water was computed for clarity on the impact of distance travelled to access water. The study computed the average distance for gender and population groups using the formula below. The mid-point was then used as the dependent variable when computing the Analysis of Variance test (ANOVA). The results show that male household heads travel an average distance of 0.321km to collect water. In comparison, female household heads travel an average distance of 0.345km to collect water in South Africa. As previously indicated, households have access to potable water if the distance travelled to the water point is not more than 200m. This result indicates that female household heads walk longer distances to source water. According to the Stats SA's definition of access to water, the results further indicate that half of the South African population does not have access to potable water. On the other hand, the results show that the average distance travelled across household head population groups to collect water from sources is Black (0.334km), Coloured (0,262km), Indian/Asian (0,1km), and White

(0.403km). The results indicate that White and Black household heads walk longer average distances to collect water. The formula below was used to calculate the average distance travelled to collect water across gender and population groups, and the results are displayed in the tables below.

$$\boldsymbol{Distance} = \frac{\sum XF}{\sum F}$$

Where

X = Mid-point between two distance is in km

F = Frequency

Table 4.20: Mean distance travelled to water sources by gender of the household head

Distance	Midpoint X (Km)	Freq. Male	XF	Freq. Female	XF
>200m	0.1	1041577	104157,7	936718	93671,8
201m-500m	0.4	473125	189250	584013	233605,2
501m-1km	0.8	162910	130328	238993	191194,4
>1km-2km	1.5	96655	144982,5	76970	115455
Total		1774267	568718,2	1836694	633926,4

Male: 0.321km (321m) Female: 0.345km (345m)

Table 4.21: Mean distance travelled to water sources by household heads' population group

Distance	>200m	201m-500m	501m-1km	>1km-2km	Total
Midpoint X (Km)	0,1	0,4	0,8	1,5	
Frequency Black/African HH	1917772	1053876	396417	165619	3533684
XF	191777,2	421550,4	317133,6	248428,5	1178889,7
Frequency Coloured HH	33558	1920	1119	3705	40302
XF	3355,8	768	895,2	5557,5	10576,5
Frequency Indian/Asian HH	5652	0	0	0	5652
XF	565,2	0	0	0	565,2
Frequency White HH	21314	1341	4368	4301	31324
XF	2131,4	536,4	3494,4	6451,5	12613,7

Black/African:0.334km, Coloured 0,262km, Indian/Asian 0,1km, White 0.402684842

4.7 Analysis of Variance Test

The analysis of variance is a technique use to test if the means of two or more independent groups are statistical significantly different from each other. In this study, the analysis of variance test is used to test whether the distance travelled in kilometres by household heads to collect water from a water source differs across province, gender and educational level of the household head. The 0.05 level of significance was used in the testing procedure as a cut-off statistic. The dependent variable is the mean distance to water as shown in Table 4.20 and Table 4.21. The distance is measured at the interval, it is the distance between two points and it is a continuous. The independent variables gender, province and educational level of the household head have two or more categories and these groups are independent from each other. Data used for this are from the General Household Survey Data and they are assumed to be normally distributed.

The ANOVA test results are displayed in Table 4.22, 4.23 and 4.24 below. Looking at Table 4.22 below, the results show that there is a statistically significant difference between the distance travelled to a water source in kilometre and province of residence, as concluded by the one-way ANOVA (F8, 3610953 = 57955.148, p = 0.00). Table 4.23 indicates that there is a significant differences between distance travelled to collect water and the different levels of education (F5, 3610956=13395.154, p=0.000). Lastly, there were significant differences in distance travelled to collect water based on the gender of the household head (F1, 3610960=10010.826, P=0.000). The large value of F is an indication that groups are greatly different from each other. To show where these differences occur across province and educational level, the Post-hoc Tukey was further performed and the results show that access to water differs across all provinces and across educational levels of the household head. See Appendices 4 and 5 for detailed results of the Post-hoc Tukey analysis; the table below shows the ANOVA test results.

Table 4.22: Distance of water source from the dwelling by province of residence

ANOVA					
Distance of water source from the dwelling by province of residence					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	302257.277	8	37782.160	57955.148	0.000
Within Groups	2354054.956	3610953	.652		

Total	2656312.233	3610961			

Table 4.23: Distance of water source from the dwelling by educational level

ANOVA					
Distance of water source from the dwelling by educational level					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	48371.904	5	9674.381	13395.154	0.000
Within Groups	2607940.328	3610956	.722		
Total	2656312.233	3610961			

Table 4.24: Distance of water source from the dwelling and gender

ANOVA					
Distance of water source from the dwelling					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	7343.854	1	7343.854	10010.826	0.000
Within Groups	2648968.379	3610960	.734		
Total	2656312.233	3610961			

4.8 Socioeconomic Determinants Influencing Access to Improved Water

As stated in Chapter Three of this research, the sampling weight was take into account when analysing the dataset. The role of sample weights in statistical analysis of survey data is a point of contention among theorists and researchers. Sampling weights when applied to descriptive analysis are generally accepted for descriptive inference about known functions of finite population values. There is a wide range of opinion regarding the use of sampling weights in regression models, with some modellers considering sampling weights to be mostly irrelevant, and others emphasising the usefulness of sampling weight in regression analysis. In this section, binary logistic regression analysis is considered in two parts. Firstly, binary regression analysis was performed with no application of sampling weights and secondly, sampling weights were applied.

In this study, eight household socioeconomic determinants were included in the analysis of the binary logistic regression model. The binary logistic regression model gives a clear indication of the odd ratio (OR) of using an improved or unimproved potable water source and their corresponding significant levels. Also in the regression model, the omnibus test of model coefficient was significant with a p-value of 0.000, while the -2-log likelihood ratio is an indication of how well the data fits into the model. The beta (β) coefficient is used to indicate the level of increase or decrease of the predictor variable. Table 4.23 below shows the logistics regression analysis based on unweighted data.

In Table 4.23 below, the gender of the household head is the first independent variable under investigation. The male household head was used as the reference group and the results show that gender is a significant predictor of a household's access to an improved or unimproved water source. The OR for females is 1.120. This implies that female household heads are 1.120 times more likely to use an improved water source, compared to male household heads. The observed results show that the gender of the household head can influence access to potable water. In addition, female household heads have high chances of having access to improved water. This further suggest that in South Africa, there is inequality in the level of access to potable water across gender lines. The second variable in the model is the province of residence of the household head. The Western Cape was used as the reference group for this category. This is because the descriptive statistics shows that the Western Cape has a high level of access to potable water. The observed result from the SPSS output shows that, except for Northern Cape, all other provinces of residence are significant predictors of access to potable water sources. The odd ratio for each province include the Eastern Cape (0.095), Northern Cape (0.711), Free State (0.133), KwaZulu-Natal (0.109), North West (0.182), Gauteng (0.192), Mpumalanga (0.198) and Limpopo (0.166), which indicates that household heads residing in the Western Cape have a better chance of accessing improved water. The result also suggests that the level of access to potable water across provinces is unequal.

Studies have shown there is a wide gap in the access of potable water between urban and rural dwellers. The third variable in the binary logistic regression model is the settlement area of the household head. The settlement area is classified into three groups in the data set: formal-urban, traditional and farm areas. The formal-urban group is used as a reference group because the descriptive statistics show the level of access to water in the formal-urban settlement area is high. The results show that the settlement area of the household head is a significant predictor of access to potable water. The odd ratios for traditional settlement and farm settlement areas are 0.125 and 0.085 respectively. This implies that household heads living in traditional settlement and farm settlement areas are less likely to use improved water, relative to household heads living in formal-urban settlement areas. This result also shows an inequality in access to potable across geographical area (urban/rural)

The fourth household socioeconomic variable in the binary logistic regression model is the population group of the household head. The Black/African household head is used as the reference category because the descriptive statistics show more household heads in South Africa are Black/African; notably, the access level for this population group was low. The results show that the population group of the household is a significant predictor of the likelihood of a household's access to improved and unimproved water sources. The odds that a Coloured household head would use an improved water source is 1.221 times more, compared to a Black/African household head. Indian/Asian household heads are 3.645 times more likely to use an improved source, relative to Black/ Africa household heads. The results show that White household heads are 0.601 times less likely to use improved water sources, compared to Black/African household heads. This suggests that Indian/Asian households have better probability of accessing improved water than Black/African, Coloured and White household heads. This result also suggests that despite the efforts being made by government to close the gap of inequality across racial lines, the level of access to water is still unequal. Surprisingly, Indian/Asian, Coloured and Black/African household heads have high probability of accessing improved water relative to White household heads. This result contradicts the popular view that the apartheids favours the White population and they had better access to basic amenities.

The age of the household head is the fifth variable under study in the binary logistic regression model output. The results show that the ages of the household head is a significant predictor of access to an improved and unimproved water source. The highest age cohort (72+) is use as a reference group because the descriptive results show that the older generation of the household heads have the lowest level of access to potable water, even though they are the most vulnerable age group and they especially need to have access to basic amenities such as water. The odd ratio for each age cohort indicates that household heads within the age groups of 12-26, 27-41, 42-56 and 57-71 are 0.441, 0.496, 0.581, and 0.787 times less likely to use an improved water source, relative to household heads aged 72 and above. The binary logistic regression model results contradict the descriptive analysis output used in the selection of this reference group because the results show that older household heads have a higher chance of accessing improved potable water. Furthermore, they suggest that an increase in the age of the household head increases the likelihood of using an improved water source.

The educational level of the household head is the model's sixth independent variable. Education is a significant predictor of access to both improved and unimproved water sources, as shown in Table 4.25. Because they have limited access to water, household heads with primary education were the reference group in this category. When comparing family heads with primary education to household heads with a college degree, the odd ratio shows that household heads with a college education are 1.551 times more likely to use an enhanced water supply. Compared to household heads with only primary education, those with a certificate/degree are 1.932 times more likely to use an improved water supply. In addition, when compared to household heads with only primary education, those with a postgraduate degree are 6.331 times more likely to use an enhanced water supply. Finally, compared to household heads with primary education, those with no schooling are 0.793 times less likely to use an improved water supply. The results show that household heads with a higher education degree are more likely to have access to a better water supply.

The monthly income of the household head and the household's income source are the seventh and eighth independent variables being investigated. The results show that the monthly income of the household head is an insignificant predictor of the household access to potable water. The odd ratio for low-income, moderate-income and high-income householders are 0.511, 0.658 and 0.369 respectively, using household heads with no monthly income as a reference group. This implies that household heads with low income, moderate income and high income are less likely to use an improved water source, relative to household heads with no income. This suggests that the monthly income of the household head does not necessarily increase the likelihood of a household head using an improved water source.

Furthermore, the result of income source of the household head shows that, salaries/wages/commission and grants (including old-age grant) are significant predictors of a household's access to improved water. Other income sources such as remittances, pension, sales of farming products, other income (rental income and interest) and no income are insignificant predictors of a household's access to improved water. Households with a salary as a source of income was used as the reference group. The odd ratio results shows that, household heads with an income source from a business (0.816), remittances (0.959), pension (0.863), grant/s (0.685), sales of farming product (0.864), other income (rental income and interest) (0.669) and no income (0.763) are less likely to use water from an improved water source, relative to household heads with income from a salary/wages/commision. This shows that household heads with an income source from salary/wages/commision have high probability of accessing water from an improved water source.

Table 4.25: Binary logistic regression of households' access to potable water

Independent variables	B	Odds ratio	P>|z|
Gender			
Male@			
Female	0.113	1.120	0.044
Province			
Western Cape@			0.000
Eastern Cape	-2.359	0.095	0.000
Northern Cape	-.342	0.711	0.379
Free State	-2.021	0.133	0.000
KwaZulu-Natal	-2.212	0.109	0.000
North West	-1.704	0.182	0.000
Gauteng	-1.652	0.192	0.000

Mpumalanga	-1.620	0.198	0.000
Limpopo	-1.797	0.166	0.000
Geographical area			
Formal urban @			0.000
Traditional	-2.077	0.125	0.000
Farms	-2.468	0.085	0.000
Population group			
Black/African @			0.000
Coloured	0.199	1.221	0.000
Indian/Asian	1.293	3.645	0.000
White	-0.509	0.601	0.000

Age			
12-26	-0.820	0.441	0.000
27-41	-0.701	0.496	0.000
42-56	-0.544	0.581	0.000
57-71	-0.240	0.787	0.013
72 @			0.000
Education			
Primary school @			0.000
College	0.439	1.551	0.000
Cert/Degree	0.658	1.932	0.000
Post-graduate degree	1.845	6.331	0.000
No schooling	-0.231	0.793	0.008
Monthly Income			
No monthly income @		.	0.105
Low income	-.245	0.511	0.709
Moderate income	-.336	0.658	0.608
High income	-.469	0.369	0.463
Income Source			
Salaries/wages/commission@			0.000
Income from a business	-0.204	0.816	0.072
Remittances	-0.042	0.959	0.663

Pensions	-0.147	0.863	0.554
Grants (including old-age grant)	-0.379	0.685	0.000
Sales of farming products and services	-0.147	0.864	0.823
Other income sources e.g. rental income, interest	-0.403	0.669	0.192
No income	-0.271	0.763	0.342
Constant	6.355	575.353	0.000

NB: In Table 4.25 sampling weight was exclude from the regression analysis model.

As previously indicated, binary logistic regression is in two parts: with the inclusion of sampling weights and with the exclusion of sampling weights. In this section, sampling weights are included before the binary logistic regression was performed and the results show that all the eight socioeconomic variables included in the analysis are significant predictors of households' access to improved and unimproved water source. This contradicts the results of the binary logistic regression without the inclusion of sampling weights. However, looking at the odd ratio in the results displayed in Table 4.26 below, it is evident that the odd ratio between the binary logistic regressions with inclusion of sampling weights, differs from the odd ratio without inclusion of sampling weights.

The gender of the household head is the first independent variable under investigation. The results show that the gender of the household head is a positive significant predictor of a household's access to water. Using the male household head as the reference group, the OR for females is 1.120, which indicates that female household heads are 1.120 times more likely to use an improved water source, relative to male household heads. The results also indicate that access to potable water is influenced by the gender of the household head and being a female household will increase the chances of having access to an improved water source. Furthermore, the results suggest that in South Africa, there is inequality in the level of access to potable water across gender lines. The province of residence of the household head is the second independent variable in the binary logistic regression model. The Western Cape was used as the reference group for this category. As indicated in the preceding section, the Western Cape was selected as the reference category because the Western Cape is among the provinces with a high level of access (see Figure 4.6). The results show that the province of residence of the household head is a significant predictor of access to potable water. The odd ratios are as follows: Eastern Cape (0.093), Northern Cape (0.699), Free State (0.131), KwaZulu-Natal (0.109), North West (0.177), Gauteng (0.174), Mpumalanga (0.186) and Limpopo (0.151). This is an indication that household heads residing in the Western Cape are more likely to use an improved water source, relative to households residing in the Eastern Cape, Northern Cape, Free State, KwaZulu-Natal, North-West, Gauteng, Mpumalanga and Limpopo. The results suggest that the level of access to potable water across provinces is unequal. This could be because the development levels across provinces differ. Although law now guarantees access to water for all, the results suggest that that there are still flaws in the way in which water is distributed across provinces.

The preceding chapter showed that there is an unequal distribution in the level of access to water across urban and rural dwellers. The third variable in the binary logistic regression model is the geographical settlement area of the household head. The geographical settlement areas are classified into three groups, viz. formal-urban, traditional and farm areas. Given that the formal-urban region has high access to potable water in the descriptive analysis (see Figure 4.7), the formal-urban group- is selected as the reference group. The results show that the settlement area of the household head is significant predictor of access to potable water. The odd ratios for the traditional settlement area and farm settlement area are 0.129 and 0.087 respectively. This suggests that household heads living in traditional and farm settlement areas are less likely to use improved water, relative to household heads living in a formal-urban settlement area. This implies that households living in the formal-urban areas have better chances of access to basic amenities and water, compared to households in traditional and farm settlement areas.

The fourth household variable in the model is the population group of the household head. The Black/African group is use as the reference category because descriptive statistics that most household heads in South Africa are Black/African (see Table 4.1). The results show that the population group of the household head is a significant predictor of the likelihood that a household will have access to improved and unimproved water sources. The odd ratios further suggest that Coloured household heads are 1.464 times more likely to use an improved water source, relative to Black/African household heads. Indian/Asian household heads are 3.902 times more likely to use an improved water source relative to Black/African household heads. White household heads are 0.632 times less likely to use an improved water source compared to Black/African household heads. This is an indication that Indian/Asian household have better likelihood of access to improved water relative to any other population group. Despite the effort made by government to close the gap of inequality across racial lines, the results show that there is still inequality in the level of access to potable water across the different race groups in South Africa. Although the majority of household heads in South Africa are Black/African, the results suggest that they are significantly affected by this inequality in the level of access to potable water.

As previously indicated, the age of the household head is a significant predictor of access to improved and unimproved water sources and is the fifth variable in the model under study. The older age cohort (72+) is used as a reference group because these household heads, classified as the older generation, have the highest of level of access to potable water, even though they are the most vulnerable age group. The odd ratios for each age cohort are as follows: 12-26 (0.463), 27-41 (0.503), 42-56 (0.620) and 57-71 (0.833). This implies that if a household head falls within the age groups of 12-26, 27-41, 42-56 and 57-71, they are less likely to use an improved water source, relative to household heads aged 72 and above. This is also an indication that an increase in the age of a household head increases the chances of accessing potable water.

The sixth independent variable in the model is the educational level of the household head. The results displayed in Table 4.26 below show that the educational level of the household head is a significant predictor of access to improved water source. Household heads with a primary education was use as a reference group, because this group is the lowest level of education for household head. The odd ratio shows that a household head with a college education is 1.511 times more likely to use an improved water source compared to a household head with a primary education. A household head with a cert/degree is 1.885 times more likely to use an improved water source compared to a household head with a primary education. Also, a household head with a post graduate degree is 9.519 times more likely to use an improved water source compared to a household head with a primary education. Finally, a household head with no schooling is 0.806 times less likely to use an improved water source, relative to a household head with a primary education. This is also an indication that households heads with a higher the level of education have higher likelihoods of having access to an improved water source.

The monthly income of the household head is the seventh independent variable examined in this study. The results show that the monthly income of household head is a significant predictor of a household's access to potable water. The odd ratios for low-income, moderate-income and high-income household heads are 0.585, 0.532 and 0.463 respectively. Household heads with no monthly income is used as a reference group because the study has shown that there is a significant relation between income and access to water. The results show that household heads with low income, moderate income and high income are less likely to use an improved water source, relative to household heads with no income. This suggests that a household head having an income does not necessarily increase the likelihood that a household will use an improved water source.

Lastly, the income source of the household head is the eighth independent variable in the model and, according to the results in Table 4.26, the income source of the household head is a significant predictor of a household’s access to potable water. Household heads with a salary as a source of income are used as the reference group. The OR results are the following: household heads with an income source from business (0.822), remittances (0.985), pensions (0.858), grants (0.667), sales of farming products (0.885), rental income (0.739) and no income (0.956). These groups are less likely to use water from an improved water source, relative to household heads with salaries/wages/commissions as an income source. This is an indication that households with a salary as a source of income have better chances of accessing an improved water source.

Table 4.26: Logistic regression of the household access to potable water

Independent variables	B	Odds ratio	P>|z|
Gender			Sig
Male @			
Female	0.109	1.115	0.000
Province			Sig
Western Cape @			0.000
Eastern Cape	-2.376	0.093	0.000
Northern Cape	-.357	0.699	0.000
Free State	-2.030	0.131	0.000
KwaZulu-Natal	-2.217	0.109	0.000
North West	-1.730	0.177	0.000
Gauteng	-1.749	0.174	0.000

Mpumalanga	-1.684	0.186	0.000
Limpopo	-1.890	0.151	0.000
Geographical Area			Sig
Formal urban @			0.000
Traditional	-2.050	0.129	0.000
Farms	-2.446	0.087	0.000
Population Group			Sig
Black/African @			0.000
Coloured	0.381	1.464	0.000
Indian/Asian	1.362	3.902	0.000
White	-.460	0.632	0.000
Age			Sig
12-26	-0.771	0.463	0.000
27-41	-0.687	0.503	0.000
42-56	-0.479	0.620	0.000
57-71	-0.182	0.833	0.000
72 @			
Education			Sig
Primary school @			0.000
College	0.413	1.511	0.000
Cert/degree	0.634	1.885	0.000
Post-graduate degree	2.253	9.519	0.000
No schooling	-0.215	0.806	0.000
Monthly Income			Sig
No monthly income @		.	0.000
Low income	-0.536	0.585	0.000
Moderate income	-0.631	0.532	0.000
High income	-0.770	0.463	0.000

Income Source			Sig
Salaries/wages/commission@			0.000
Income from a business	-0.196	0.822	0.000
Remittances	-0.015	0.985	0.000
Pensions	-0.153	0.858	0.000
Grants (including old-age grants)	-0.405	0.667	0.000
Sales of farming products and services	-0.122	0.885	0.000
Other income sources e.g. rental income, interest	-0.303	0.739	0.000
No income	-0.045	0.956	0.000
Constant	6.681	796.762	0.000

NB: In Table 4.26 sampling weight was include in the regression analysis.

4.9 Socioeconomic Determinants Influencing Households' Perceptions of Water

The household socioeconomic determinants that account for households' perception of the quality of their drinking water were examined in this study. Following the findings from the reviewed literatures, the study hypothesises that socioeconomic and demographic variables such as gender, province of residence, age and monthly income are some of the determinants that are strongly associated with perceptions of the quality of drinking water. To understand the influence of these socioeconomic determinants on perceptions of the quality of a household's water, a binary logistic regression analysis was performed. This analysis is used to show the relationship between perceptions of the quality of drinking water and a set of explanatory variables, as mentioned above. The dependent variables in the fitted binary logistic regressions are the organoleptic properties of water (safety, clarity, taste, and odour). This binary logistic regression is analysed in two parts: binary regression analysis was analysed with no application of sampling weights and with the application of sampling weights. Looking at the binary logistic regression analysis results in Table 4.27 horizontally, the results show that there are four dependable variables that are used to examine households' perception of the quality of their water and each of the dependent variables was analysed separately with the five different socioeconomic variables.

4.9.1 Socioeconomic determinants influencing households' perceptions of water safety

Vertically, the gender of the household head is the first independent variable and water safety is the first dependable variable in Table 4.27. The results show that the gender of the household head is a non-significant predictor of water quality. This suggests that the gender of the household head does not influence households' perception of water safety. However, the odd ratio for gender shows that female household heads are 1.056 times more likely to perceive their water as safe, relative to male household heads. This indicates that, even though gender of the household head is a non-significant factor in determining how households perceive the quality of water they consume, females are more likely to perceive their household's main source of potable water as safe. The gender of the household head is followed by the geographical area of the household head. As previously indicated, the geographical area is divided into two: metro and non-metro area. In the binary logistic model, the metro area was used as a reference group because, unlike non-metro areas, the metro areas are more developed and have more social structures, such as buildings and roads. The results for the unweighted binary logistic regression show that a household's geographical area of residence is a non-significant factor in determining the household's perception of the water quality. Nonetheless, the odd ratio indicates that household heads living in a non-metro area are 1.065 times more likely to perceive their potable water as safe, compared to household heads living in a metro area.

The age of the household head is the third socioeconomic variable in the binary logistic regression model. The age 72 and above was used as a reference group because they are more sensitive to the water they consume. The results indicate that the age of the household head is a non-significant predictor of the perception of safety of the household's water. The OR show the following: household heads aged 12-26, 27-41 and 42-56 are 1.194, 1.076 and 1.077 times more likely to perceive their household's main source of potable water as safe, relative to household heads aged 72 and above. On the other hand, the OR for household heads aged 57-71 indicates that households are 0.999 less likely to perceive their main source potable water as safe, relative to household heads aged 72 and above. What is observed in this result is, although there is no statistical relationship between the ages of the household heads and their perception of water safety, more household heads that are active in the labour force are more likely to perceive that their main source of potable water is safe to drink.

The influence of the household province of residence and perception of water safety were examined and the result of the binary logistic regression shows that province is a significant predictor of a household's perception of water safety. The OR shows the following: the Eastern Cape (0.234), Northern Cape (0.156), Free State (0.145), KwaZulu-Natal (0.188), North West (0.281), Gauteng (0.301), Mpumalanga (0.690) and Limpopo (0.177) are less likely to perceive their main source of potable water as safe, relative to household heads living in the Western Cape.

The influence of the household head's monthly income and perception of water safety was also examined. The study argues that a household head's income can influence their perception of their main source of potable water. The binary logistic regression in Table 4.27 shows that a household head's income is a non-significant predictor of the household's perception of water safety. It implies that the income of the household head does not influence a household's perception of water safety. The OR shows the following: low-income householder (0.423), moderate-income (0.305) and high-income (0.268); these are less likely to perceive their main source of potable water as safe, relative to household heads with no monthly income.

4.9.2 Socioeconomic determinants influencing households' perceptions of water clarity

Clarity of the household's main source of water is the second dependent variable in Table 4.25. Five household socioeconomic variables were analysed in the binary logistic model. Sampling weight was excluded when performing the analysis. The results show that the gender of the household head is a non-significant predictor of the perception of the household's water clarity. It implies that gender does not influence a household's perception of water quality. The OR shows that female household heads are 1.046 times more likely to perceive that their main source of potable water is clear, relative to male householders. This suggests that male household heads have lower chances of perceiving that the household's main source of the potable water is not clear. Household heads in a geographical area are the second independent variable in the model: the results show that when a householder's area of residence is in a metropolitan area, it has a non-significant relationship to their perception of water quality. The odd ratio indicates that household heads living in the non-metro areas are 1.065 times more likely to perceive that their main source of potable water is clear, compared to household heads living in metro areas.

The results in Table 4.27 show that household heads' age is non-significant in predicting household's perception of their water quality. The odd ratios are as follows: 12-26 (1.202), 27-41 (1.166), 42-56 (1.154) and 57-71 (1.046); these age groups have a high likelihood of perceiving that the household's main source of potable water is clear, relative to household heads aged 72 and above. This suggests that as the age of the household head increases, their perception of water clarity decreases. The study also investigated the perception of water clarity across household heads' province of residence. The results show that except for

Mpumalanga with a non-significance level of 0.181, which is higher that the cut-off statistic of 0.05, all other provinces are significant determinants of the households' perception of water clarity. The odd ratios are as follows: that the Eastern Cape (0.403), Northern Cape (0.239), Free State (0.192), KwaZulu-Natal (0.172), Northwest (0.387), Gauteng (0.273), Mpumalanga (0.822) and Limpopo (0.235); these provinces are less likely to perceive the household's main source of potable water as clear, relative to household heads living in the Western Cape.

The household head's income, which is the fifth independent variable, is non-significant when predicting households' perception of water quality, which implies that the income of the household head does influence households' perception of water clarity. Using household heads with no monthly income as a reference group, the odd ratios are indicated as follows: low-income household heads (1.726), moderate-income (1.563), high-income (2.076); these groups are more likely to perceive their potable water as clear, relative to household heads with no monthly income. This suggests that household heads with an income have a high probability of perceiving that the household's main source of potable water is clear.

4.9.3 Socioeconomic determinants influencing households' perceptions of water taste

The taste of the household's main source of water is the third dependent variable in Table 4.27, which examines the households' socioeconomic determinants that influence perception of water quality. The binary logistics regression shows that the gender of the household head is a non-significant determinant of the households' perception of water quality. The OR shows female household heads are 1.024 times more likely to perceive that the taste of the household's main source of potable water is good, relative to male household heads. The results show that male-headed households have a low probability of perceiving their main source of potable water has good taste.

The influence of household heads in geographical areas of residence was also examined. The result indicate that residence in metropolitan areas is a non-insignificant predictor of how households perceive the taste of their main source of potable water. The odd ratio results are an indication that households in the non-metro areas are 0.998 times less likely to perceive that the household's main source of potable water tastes good, compared to households in metro areas.

The influence of the household heads' ages on perception of water quality was examined. The result indicate that the age of a household head is a non-significant predictor of the household's perception of the taste of their main source potable water. Using age 72+ as a reference group, the OR results are the following: age 12-26 (1.202), 27-41 (1.166), 42-56 (1.154) and 57-71 (1.046)' these groups are more likely to perceive that the taste of the household's main source of potable water is good, relative to household heads aged 72 and above.

The province of residence is an important socioeconomic factor that was studied, with regard to taste as a perception of water quality. The results show that at 0.05, which is the cut off significant level, the North West province of residence is a non-significant predictor of household perception of water taste. The odd ratio for the North West province shows that households are 0.950 times less likely to perceive that the household's main source of water tastes good, relative to the Western Cape. On the other hand, the Eastern Cape, Northern Cape, Free State. Kwazulu-Natal, Gauteng, and Limpopo are significant determinants that influence households' perception of water taste. The observed ORs are as follows: Eastern Cape (0.746), Northern Cape (0.430), Free State (0.468), Kwazulu-Natal (0.727), Gauteng (0.636), and Limpopo (0.500); this shows that household heads' residence in these provinces have a low probability of them perceiving that the household's main source of potable water tastes good, compared to the Western Cape. The results also show that Mpumalanga province is significant in predicting how household heads perceive the taste their main source of potable water. The OR for Mpumalanga (1.871) is an indication that household heads residing in Mpumalanga have high odds of perceiving that their household's main source of potable water tastes good, relative to the Western Cape.

The monthly income of the household head is one of the socioeconomic variables under investigation. The results as indicated in Table 4.27 show that income is not a significant predictor of perception of water quality. This implies that the income of the household head does not influence the perception of taste of the main source of potable water. The odd ratios show that household heads with low income (1.464), moderate income (1.520), and high income (1.434) are more likely to perceive that the taste of their potable water is good, relative to household heads with no income.

4.9.4 Socioeconomic determinants influencing households' perceptions of water odour

The fourth dependent variable used in the fitting of the binary logistics regression model is the smell of water. As mentioned above, there are five independent variables (gender, geographical area, age, province and income). Binary logistic regression was used to find the relationship between household heads' socioeconomic variables and smell of water as a perception of water quality. The results show that the gender of the household head which is the first independent variable in Table 4.27, is a non-significant predictor of a household's perception of water quality (water odour). The OR shows that females are 1.022 times more likely to perceive that the household's main source of potable water is free from a bad smell, relative to male household heads. Household heads resident in metropolitan areas is the second independent variable under study. The results show that the non-metro areas of residence is a non-significant predictor of how households perceive their main source of potable water. The OR for a non-metro area (1.045) shows that households in non-metro areas are 1.045 times more likely to perceive that the household's main source of potable water has a good smell. This implies that households in metro areas have a lower probability of perceiving that the taste of their main source of water is good.

The age of the household head is the third socioeconomic variable under investigation. The results indicate that the household heads' age is a non-significant predictor of how household perceive the smell of the household's main source of potable water. While holding age 72+ constant, the OR results show household heads of ages 12-26, 27-41 and 42-56 are 1.255, 1.110 and 1.038 times more likely, respectively, to perceive that the household's main source of water smell goods. On the other hand, the OR for household heads aged 57-71 indicates they are 0.979 times less likely to perceive that the odour of the household's main source of potable water is good, compared to household heads aged 72 and above.

Households' province of residence is the fourth independent variable under study. The results show that Eastern Cape, Northwest and Gauteng are non-significant predictors of how households perceive their main source of potable water quality (water odour). The ORs show that the Eastern Cape (0.854), North-West (0.806) and Gauteng (0.900) have low odds of perceiving that the household's main source of water has good taste. The Northern Cape, Free State. Kwazulu-Natal, Gauteng, and Limpopo are significant factors that can predict that the household's main source of water has a good smell. The odd ratios for the Eastern Cape, Northern Cape (0.642), Free State (0.567) Kwazulu-Natal (0.513), North West (0.974), Gauteng (0.900), and Limpopo (0.177) show that households in this province are less likely to perceive that their main source of potable water has a good smell, relative to household heads in the Western Cape. Mpumalanga province is also a significant factor, the OR of 1.731 indicates that households in Mpumalanga are more likely to perceive that the household's main source of potable water smells good, relative to households in the Western Cape.

The monthly income of the household head shows that household head income is a non-significant predictor of perception of water quality. The odd ratios show that household head with low income (1.625), moderate income (1.367) and high income (1.820), are more likely to perceive that the household's main source of potable water has a good smell, compared to household heads with no-monthly income.

Table 4.27: Logistic regression of the households' perception of water quality

Independent variables	**Water safety**		**Water clarity**		**Water taste**		**Water odour**	
	Odd ratio	**Sig.**	**Odd ratio**	**Sig.**	**Odd ratio**	**Sig.**	**Odd ratio**	**Sig.**
Gender of household of head								
Male@								
Female	1.056	0.308	1.046	0.404	1.024	0.634	1.022	0.693
Metropolitan area								
Metro@								
Non-metro	1.065	0.264	1.076	0.192	0.998	0.971	1.045	0.442
Age group								
12-26	1.194	0.198	1.202	0.175	1.202	0.106	1.255	0.208
27-41	1.076	0.454	1.166	0.116	1.166	0.299	1.110	0.106
42-56	1.077	0.448	1.154	0.143	1.154	0.709	1.038	0.299
57-71	0.999	0.988	1.046	0.657	1.046	0.833	0.979	0.709
72+		0.533		0.292		0.208		0.833
Province								
Western Cape@		0.000		0.000		0.000		0.000
Eastern Cape	0.234	0.000	0.403	0.000	0.746	0.013	0.854	0.212
Northern Cape	0.156	0.000	0.239	0.000	0.430	0.000	0.642	0.000
Free State	0.145	0.000	0.192	0.000	0.468	0.000	0.567	0.000

Kwazulu-Natal	0.188	0.000	0.172	0.000	0.727	0.014	0.513	0.000
North West	0.281	0.000	0.387	0.000	0.950	0.610	0.974	0.806
Gauteng	0.301	0.000	0.273	0.000	0.636	0.000	0.900	0.411
Mpumalanga	0.690	0.000	0.822	0.181	1.871	0.000	1.731	0.000
Limpopo	0.177	0.019	0.235	0.000	0.500	0.000	0.615	0.000
Monthly income								
No monthly income@		0.124		0.342		0.869		0.189
Low income	0.423	0.404	1.726	0.284	1.464	0.450	1.625	0.381
Moderate income	0.305	0.249	1.563	0.381	1.520	0.409	1.367	0.571
High income	0.268	0.199	2.076	.148	1.434	0.470	1.820	0.275

NB: In Table 4.27 sampling weight was excluded from the regression analysis.

4.10 Socioeconomic Determinants Influencing Households' Perceptions of Water

In this section, sampling weights are included before the binary logistic regression was performed. The outcome of the analysis is displayed in Table 4.28. Looking at Table 4.28 horizontally, there are four dependent variables (water safety, clarity, taste and smell). Vertically, there are five independent variables (gender, geographical area, age, province of residence and income). Each dependent variable was use to analyse the independent variables distinctively. The cut-off statistic is 0.05.

4.10.1 Socioeconomic determinants influencing household perceptions of water safety

For water safety, the results show that at a significance level of 0.000 the gender of the household head is a significant predictor of a household's perception of water safety. It implies that there is a relationship between perception of water quality and the gender of the household head. The OR for females is an indication that female household heads are 1.034 times more likely to perceive household water safe to drink, relative to male household heads.

The results suggest that the gender of the household head influences a household's perception of water safety and male household heads have a lower chance of perceiving that the household's main source of water is safe to drink. The geographical area of residence is the second socioeconomic variable used in the study. Since a metro region is a more developed area compared to a non-metro area, it was chosen as the reference group. The results show that a geographical area is a significant predictor of the household's perception of water safety. The odd ratio indicates that households in a non-metro area are 1.021 times more likely to perceive their main source of potable water as safe to drink, compared to households in a metro area.

The household heads' age is the third independent variable in the logistic regression model. Household heads aged 72 and above was used as a reference group. The result indicate that the age of the household heads is a significant predictor of a household's perception of water safety. The ORs for ages 12-26, 27-41 and 42-56 show that household heads are, respectively, 1.165, 1.029 and 1.052 times more likely to perceive their potable water as safe to drink, relative to household heads aged 72+. The OR for ages 57-71 indicates that household heads are 0.990 less likely to perceive their main source of potable water as safe to drink, relative to household heads age 72 and above.

The fourth variable in the logistic regression model is the province of residence. The results show that the province of residence of the household head is a significant predictor of a household's perception of water safety. The ORs are an indication that the Eastern Cape (0.221), Northern Cape (0.152), Free State (0.137), KwaZulu-Natal (0.171), North West (0.270), Gauteng (0.307), Mpumalanga (0.654) and Limpopo (0.170) are less likely to perceive their main source of potable water as safe to drink, compared to household heads living in the Western Cape. This suggests that households in the Western Cape have a high probability of perceiving that the household's main source of water is safe to drink.

The study investigated the influence of the household head's monthly income on a household's perception of water safety. The results show that household income level is a significant predictor of the household's perception of their water. Using household heads with no monthly income as a reference group, the ORs show that low-income household heads (0.405), moderate-income (0.295) and high-income household heads (0.246), are less likely to perceive their main source potable water as safe to drink, relative to household heads with no monthly income. This suggests that the income of the household head can influence household perception of water safety.

4.10.2 Socioeconomic determinants influencing households' perceptions of water clarity

The second dependent variable in Table 4.28 is water clarity. The logistic regression results show that the first independent variable, gender of the household head, is a significant predictor of a household's perception of water quality (water clarity). The odd ratio shows that female household heads are 1.045 times more likely to perceive that the household's main source of potable water is clear, relative to male household heads.

The geographical area is the second independent variable in the model. The geographical area is a significant predictor of a household's perception of water clarity. The odd ratio shows that households in the non-metro area are 1.045 times more likely to perceive that their main source potable water is clear compared to household in metro area.

Furthermore, the age of the household head was examined in terms of perceptions of water clarity. The results indicate that the age of the household head is a significant predictor of the household's perception of water clarity. Using age 72 and above as a reference group, the odd ratio results indicate that ages 12-26 (1.162), 27-41 (1.110), 42-56 (1.130) and 57-71 (1.026) are more likely to perceive that the household's main source of potable is clear, compared to household heads age 72 and above. This suggest household heads' gender, geographical area of residence and age are significant predictors of the household's perception of water clarity.

The household head's province of residence is the fourth variable under study. The results show that provinces are significant predictors of a household's perception of water clarity. Using the Western Cape as a reference group, the ORs show that households in the Eastern Cape (0.362), Northern Cape (0.226), Free State (0.180), KwaZulu-Natal (0.158), North West (0.357), Gauteng (0.265), Mpumalanga (0.735) and Limpopo (0.226) are less likely to perceive that the household's main source of potable water is clear, relative to household in the Western Cape.

The monthly income of the household head is the fifth variable in the model. At a significance level of 0.05, the income of the household head is a significant predictor of the household's perception of water clarity. The ORs indicate that household heads with low income (1.726), moderate income (1.563) and high income (2.076) are more likely to perceive that their potable water is clear, relative to household heads with no monthly income. This suggests that household heads' province of residence and income are significant predictors of the household's perception of water clarity.

4.10.3 Socioeconomic determinants influencing household perceptions of water taste

Furthermore, regarding water taste, the third dependent variable in Table 4.28 was examined with the households' socioeconomic variables under investigation. The binary logistic regression shows that the gender of the household head is significant. The odd ratio shows that females are 1.014 times more likely to perceive that the taste of their potable water is good, relative to males. In the same way, the geographical area is a significant predictor of a household perception of water taste. The OR indicates that households in a non-metro area are 0.949 times less likely to perceive that the household's main source of potable water taste is good, compared to households in a metro area. This suggests that households living in a metro region are more satisfied with the taste of their potable water.

The age of the household head was examined as well and the results indicate that at a significant level of 0.654, there is no relationship between a household head aged 12-26 and perception of water taste. However, an OR of 1.002 indicates that household heads aged 12-26 are more likely to perceive that the household's main source of water taste is good. The result for age group 27-41 shows that there is a significant relationship between household age 27-41 and perception of water taste. The OR shows that household heads aged 27-41 are more likely perceive that the household's main source of water taste is good, relative to household heads aged 72+, which is the reference group. Household heads aged 42-56 and 57-71 are statistically significant factors in the predicting of a household's perception of water taste. The ORs of 0.956 and 0.890, respectively, are an indication that household heads aged 42-56 and 57-71 are less likely to perceive that the taste of their main source of potable water taste is good, relative to household heads aged 72+. This implies that how households perceive the taste of water they drink is influenced by age of the household head.

For province of residence, the results show that household head's province of residence is a significant determinant of perception of water taste. The ORs for the Eastern Cape (0.735), Northern Cape (0.438), Free State (0.475). Kwazulu-Natal (0.721), North West (0.975), Gauteng (0.678), and Limpopo (0.523) show that households in these provinces are less likely to perceive the taste of the main source of potable as good, relative to households in the Western Cape. The OR for Mpumalanga (1.891) shows that households in Mpumalanga are more likely to perceive the taste of their potable water is good, relative to households in the

Western Cape. This suggests that the Western Cape and Mpumalanga show higher likelihood of households perceiving the taste of their potable water as good.

The monthly income of the householder, which is the sixth socioeconomic variable, is also a significant predictor of perception of water taste. The odd ratios show that householders with low income (1.508), moderate income (1.403) and high income (1.352) are more likely to perceive that the taste of their household potable water is good. This suggests that household heads' income increases the probability of perception of water taste as good

4.10.4 Socioeconomic determinants influencing household perceptions of water smell

Water smell is the fourth dependent variable in the binary logistics regression model. The results of the analysis show that the sex of the household head is a significant predictor of how a household perceives their main source of potable water. The OR shows that female household heads are 1.029 times more likely to perceive that the household's potable water smells good, relative to male household heads. The geographical area of the household head is also a significant predictor of how households perceived potable water quality (water odour). The OR shows that households in a non-metro area are 0.997 times less likely to perceive that the smell of the household potable water is good, compared to households in a metro region.

The age of the household head indicates that ages 27-41, 12-26 and 42-56 are a significant predictor of the household's perception of potable water smell, whereas the age group of 57-71 is a non-significant predictor of how households perceives the smell of their potable water. Using age 72 and above as a reference group, the odd ratios results for water smell shows ages 12-26 and 27-41 are 1.237 and 1.090, respectively, more likely to perceive that the smell of the household potable water is good, compared to household head aged 72+. On the other hand, the odd ratios for householders aged 42-56 and 57-71 indicate that household heads in these age groups are 0.999 and 0.969 times less likely, respectively, to perceive that the smell of their potable water is good, compared to household heads aged 72 and above. This suggests that younger household heads have high probabilities of perceiving that the household's main source of potable water smells good.

For province of residence, the results show that all nine provinces are significant in the model, and they are predictors of how households perceive the smell of their main source of potable water. The ORs for the Eastern Cape (0.849), Northern Cape (0.656), Free State (0.578), Kwazulu-Natal (.0527), North-West (0.990), Gauteng (0.949), and Limpopo (0.654) show that households in these provinces are less likely to perceive the smell of their potable water as good, relative to households in the Western Cape. Also, using the Western Cape as a reference group, the results show that households in Mpumalanga are 1.711 times more likely to perceive the odour of their potable water as good, relative to household heads residing in the Western Cape. The results in Table 4.28 show that household heads' monthly income is a significant predictor of perception of water smell. The odd ratios show that householders with low income (1.630), moderate income (1.484) and high income (1.825) are more likely to perceive that the household's potable water smell is good, relative to household heads with no monthly income. This suggests that the household income is not a predictor of household's perception of water quality (odour).

Table 4.28: Logistic regression of the households' perception of water quality

Independent Variables	Water safety		Clarity of water		Taste of water		Smell of water	
	Odd Ratio	Sig.	Odd ratio	Sig.	Odd ratio	Sig.	Odd ratio	Sig.
Gender								
Male@								
Female	1.034	0.000	1.045	0.000	1.014	0.000	1.029	0.000

Geographical area								
Metro@								
Non-metro	1.021	0.000	1.045	0.000	0. 949	0.000	0.997	0.147

Age group								
12-26	1.165	0.000	1.162	0.000	1.002	0.654	1.237	0.000
27-41	1.029	0.000	1.110	0.000	1.018	0.000	1.090	0.000
42-56	1.052	0.000	1.130	0.000	0.956	0.000	0.999	0.000
57-71	0.990	0.012	1.026	0.000	0.890	0.012	0.969	0.892
72+		0.000		0.000		0.000		0.000
Province								
Western Cape@		0.000		0.000		0.000		0.000
Eastern Cape	0.221	0.000	0.362	0.000	0.735	0.000	0.849	0.000
Northern Cape	0.152	0.000	0.226	0.000	0.438	0.000	0.656	0.000
Free State	0.137	0.000	0.180	0.000	0.475	0.000	0.578	0.000
Kwazulu-Natal	0.171	0.000	0.158	0.000	0.721	0.000	0.527	0.006
North West	0.270	0.000	0.357	0.000	0.975	0.000	0.990	0.000
Gauteng	0.307	0.000	0.265	0.000	0.678	0.000	0.949	0.000
Mpumalanga	0.654	0.000	0.735	0.000	1.891	0.000	1.711	0.000
Limpopo	0.170	0.000	0.226	0.000	0.523	0.000	0.654	0.000
Monthly Income								
No monthly income@		0.000		0.000		0.000		0.000
Low income	0.405	0.000	1.726	0.000	1.508	0.000	1.630	0.000
Moderate income	0.295	0.000	1.563	0.000	1.403	0.000	1.484	0.000
High income	0.246	0.000	2.076	0.000	1.352	0.000	1.825	0.000

NB: In Table 4.28 sampling weight was include from the regression analysis

4.10 Conclusion

This chapter explored water access and perceptions of the quality of water in South Africa in depth. Data from the General Household Survey was used to examine households' access to water and perception of water quality. The relationships between water access and perception of water quality in relation to households' socioeconomic variables was investigated with the used of descriptive and inferential statistics. Provinces such as Gauteng and the Western Cape, according to the findings, have high levels of access and high perceptions of water quality. According to the data analysis, there is a substantial relationship between households' socioeconomic indicators and access to water. This relationship became clearer when sample weights were included in the data set before data analysis, as all the socioeconomic variables became significant determinants that hinder households' access to potable water. Furthermore, the study finds that households' socioeconomic variables play a vital role in determining households' access to water and perceptions of water quality. In the next chapter, the findings will be discussed extensively, based on weighted results because they produce smaller standard deviations and give good estimates of the parameters under investigation. See Appendix 6 and 7 for detailed regression results.

CHAPTER FIVE: DISCUSSION OF RESULTS

5.1 Introduction

This chapter discusses the analysed data in relation to the research's main objectives, questions, and hypotheses. The goal of this research is to investigate the factors that influence household access to and perceived quality of water in South Africa. To accomplish the study's goal, several key socioeconomic determinants were identified, based on reviewed literatures, and data from the Statistics of South Africa (Stats S.A.) 2018 General Household Survey was used. In order to analyse the data, the study used descriptive analysis, ANOVA, and regression models. The discussion section is structured in such a way that the relationship between households' access to water, perceptions of water quality and the household variables under research, is clearly addressed. The research problem, questions, hypotheses, and method of analysis are highlighted to begin the chapter, which is followed by the discussion section. It is also worth mentioning that the regression analysis was performed using both weighted and unweighted data. The discussion focuses on the weighted results because it ensure that there is consistency in the results and removes bias in the estimation and accounts for over and under coverage that may have occurred during the data collection process.

5.2 Reiterating the Problem Statement

The problem statement for this study was clearly stated in Chapter One. In the problem statement, the importance of households' access to water and perceptions of the quality of water households have access to was highlighted. Clearly, there are inequalities and disparities in the quality and accessibility of households' potable water. Also highlighted is the fact that these inequalities in access to water are seen across provinces, gender, racial lines, household heads' educational level and their income levels. The problem with access to water and perceptions of water quality has been addressed by researchers, however, there is still an evident lack of research on the topic and the discrepancies in households' access to water and perception of water quality persist. Giving the importance of access to safe and quality water, there is a pressing need to address the socioeconomic determinants that hinder households from accessing potable water in South Africa and elsewhere. This study contributes to this aforementioned body of research by finding the relationships between household socioeconomic variables, such as distance to water source, age, gender, population group, education level, monthly income and income source, with the household heads' access to water and their perception of the water quality. Different research questions and hypotheses were formulated as indicated in Chapter One, to address the research problem. In the next section, the research methods used in answering the research questions and hypotheses are recapped.

5.3 Reiterating the Methodology used in the Study

This study's research methodology and design are outlined in detail in Chapter Three. The research methodology is crucial because it shows the research technique, defines the characteristics of variables used in the study and the accompanying methods used to realise the research aims and objectives. The study has focused on determinants of households' access to and perceptions of the quality of water in South Africa. It addresses household determinants responsible for unequal access to water and household determinants that influence how households perceive the quality of water utilised within the household. Data from Stats S.A.'s 2018 South Africa General Household Survey were used in this study. Statistics of South Africa collects data of this nature mainly for the purpose of informing the government regarding developments and performance.

A cross-sectional design, generally well-known for use in survey research, was utilised in this study, and all the nine provinces in South Africa were included in the analysis. The survey circulated by Statistic South Africa was conducted using questionnaires. A questionnaire was used to obtain data such as gender, education, income, the household's water sources and perception of water quality from respondents. The unit of the analysis and unit of observation for the study is the household and household head. Determinants were also selected based on reviewed literatures and the stated research purpose. Household head variables such age, gender, education, province, place of resident, income source, household head's monthly income, distance to water source, and perception factors (taste, colour and odour of water) were extracted from the data set. Details of measurements of variables have been defined in Chapter Three.

The study, which is quantitative in nature, makes use of both descriptive and inferential statistics. Before the analysis was performed, data was weighted to become a true representation of the population. The descriptive method of analysis was used to describe each of the variables under study and they were related to access to water. This was followed by a chi-square test that was used to determine whether, statistically, there are significant associations between households' drinking water sources and two or more independent groups. The distance to a water source was used as a proxy for access and cross-tabulated with gender and educational level. Furthermore, the ANOVA test was employed to establish if the mean distance travelled to a water source differs across gender, province and educational level of the household head. Furthermore, binary logistic regression was used to establish the relationship between access to water and socioeconomic determinants. The 2018 General Household Survey (GHS) data were obtained from Statistics South Africa as previously indicated; the data was already in an SPSS format, making it easy to perform the different analyses for the study. All nine provinces were included in analysis and the SPSS software was used to perform all analysis. The findings in Chapter Four are analysed in order to answer the research questions and to test the hypotheses of this study. The next section is the discussion of results and it captures the outcome of results in terms of access to water and perceptions of water.

5.4 Discussion of Results

As indicated in previous chapters, many countries, notably those in Africa, continue to experience a lack of access to adequate potable water and inequitable distribution of this basic service. Given that, in 2015, approximately 663 million people worldwide used unimproved potable water (that is, water that is not protected against contamination, including vended water and unprotected well, spring, or surface water) and 159 million people relied on surface water such as rivers, streams, lakes, ponds, dams, canals, and irrigation channels (WHO/UNICEF JMP, 2015). The issue of lack of access to potable water is one that is also peculiar to South Africa, the focus of the study and as previously indicated, there is inequality in the spatial distribution of water across the national territory. To ascertain the inequalities in access to water the following research question was formulated: What relationships exist between access to water and socioeconomic variables such as distance to water source, age, gender, population group, education level, monthly income, and income source of the household head? The purpose of this question is to understand the level of access to water as of 2018 and to ascertain if distribution of water varies across province and geographical settlement and household socioeconomic variables such as gender, age, monthly income, income source, and educational level of household head.

For simplicity and clarity, the main source of drinking water in South Africa was subdivided into three groups namely: piped water on the premises, other improved sources and unimproved sources, using the 2015 WHO/UNICEF Joint Monitoring Programme (JMP) method of classification. According to the data from the descriptive analysis findings, approximately 43% of household heads have piped water in the premises/yards, while approximately 48 % use other improved water sources such as piped (tap) water on site or in their yard, borehole on site, and public/communal tap, among others. In addition, 9% used unimproved water sources such as stagnant water/dam/pool and surface water (flowing water/stream/river), among others (see Figure 4.1). These findings are closely related to the 2018 report on access to water by Stats S.A. (Stats S.A., 2018). Even though the Stats S.A. results indicate that access to water in South Africa is 89.0 % as of 2018, this study reports using data from the same 2018 data set indicate that 43% of household heads have piped water in the premises/yards, while approximately 48% use other improved water sources. The slight difference in the total percentage could be as a result of classification method used by this study and that used by Stats S.A. However, both results indicate that access to water has increased over time in South Africa.

Furthermore, the level of access to water was investigated across province of residence. A descriptive cross tabulation and chi-square test of association were used to analyse the data. According to the findings from the data analysis in the preceding Chapter, the result on the percentage distribution of access to water across province (see Figure 4.6) indicates that 77.5% of households in Western Cape have access to piped water in the premises, followed by 62.6% in Gauteng and 51.6% in the Northern Cape. For other provinces access to piped water in the premises is below 50%. For access to other improved water sources, Limpopo (71.6%), Mpumalanga (64%) and North West (63.6%) have the highest level of access in this category. According to the results, more households in the Eastern Cape (15.8%) and Limpopo (15.5%) have access to unimproved water sources. In general, the results show that for access to potable water, the Western Cape and Northern Cape have the highest level of access to water and the provinces with the lowest level of access to potable water are Limpopo and the Eastern Cape. This result corresponds with the result reported by Stats S.A. It was indicated in the results that tap water inside their dwellings, off-site or on-site are mostly common among households in the Western Cape, Gauteng and the Northern Cape and also, access in these provinces has been relatively stable from 2002 to 2018 (Stats S.A., 2018). However, access level to piped water in dwellings, off-site or on-site are less common in the Eastern Cape and Limpopo (Stats S.A., 2018). The result shows that there is inequality in access to water and this is also true according to the Department of Water and Sanitation (DWS) (2016). The results show that access to water is unequally distributed across national province. Provinces like the Western Cape that are more developed in terms of infrastructure, have better access, compared to Limpopo that is underdeveloped, because the water policy is the same, but poverty and deployment levels differ. To address this inequality, the policy on water should be made according to provincial development.

Inequality in access to water across urban and rural areas is one of the data disaggregation dimensions included in the Sustainable Development Goals' global monitoring framework. The results on access to water across geographical location, as shown in Figure 4.7 in the previous chapter, revealed that households in the formal-urban settlement areas have the highest level of access to piped water in the premises, followed by households in the farming and traditional settlement areas. More households in traditional and farm settlement areas are seen to have access to potable water from other improved sources. This implies that in the traditional and farm areas, which are equivalent to rural areas, households tend to get their water from off-site or on-site taps as well as communal taps. According to the findings, households in the farm and traditional settlement areas also have the highest level of access to unimproved water sources. Furthermore, the findings show that urban areas have better access to potable water than rural areas (traditional and farm areas). This report is consistent with UNICEF and WHO's (2017) findings, which are that the global proportion of rural dwellers consuming unimproved water is more than that of the urban population. The logistic regression (see Table 4.26) further shows that households in formal-urban areas are more likely to use improved water, compared to households in the farm and traditional settlement areas. These findings are consistent with research carried out by Irianti et al. (2016) and Tuyet-Hanh et al. (2016), which found that urban households were 2.6 and 2.2 times more likely to use improved as opposed to unimproved drinking water sources. In the context of South Africa, the findings substantiated the findings of Cole et al. (2017), who found that 65% of urban dwellers have piped water in their dwellings, 34 % on farms, and only 8% of the population living in traditional/tribal areas have this level of access. In addition, 90% of those with piped water live in urban areas. It was established that the geographic location, rather than the type of dwelling, influences access to water. It is therefore imperative that water board organisations should focus on farm and traditional settlement areas when providing more off-site or on-site taps and communal taps that will help bridge the gap of unequal access to water across geographical location.

5.5 Households' Access to Water by Household Socioeconomic Determinants.

Researchers have continued to pay significant attention to understanding how to provide everyone with access to clean and sufficient potable water, particularly because it is linked to the objectives of the Sustainable Development Goals (SDGs) and it is a fundamental human right. However, research has found that socioeconomic determinants continue to hinder households' access to safe potable water. In light of this, the purpose of this research is to determine how socioeconomic determinants influence households' access to potable water.

The following general research question was designed to establish the association between households' socioeconomic variables and access to water: *What relationships exist between access to water and socioeconomic variables such as distance to water source, age, gender, population group, education level, monthly income, and income source of the household head?* The goal of this question was to determine whether or not these determinants prevent households from accessing potable water. The next section addresses the specific research questions as well as their hypotheses.

Research question: How does the gender of the household head affect access to a potable water source?

Hypothesis: Households headed by females are less likely to have access to improved water sources.

The aim of this question is to determine if the gender of a household head influences access to potable water. To answer this question, the Stats S.A. 2018 General Household Survey data set was used in the analysis and households' main source of potable was divided into three different categories. According to the findings of the data analysis in the previous chapter, the results regarding percentage distribution of main source of water by gender of household head (see Figure 4.2) showed that more male household heads have access to piped water in the premises, while more females have access to other improved water and unimproved water sources. The chi-square test was further used to analyse the association between a household head's gender and the household`s main source of water, with $p<0.05$. The results show that there is a relationship between the gender of a household head and access to water (see Table 4.2). However, the phi and Cramer's V test show a weak association between the gender of household head and access to potable water. This finding supports Dungumaro's (2007) claim that, to a lesser extent, the gender of the head of the household is a statistically significant predictor of living in a household that collects water from a safe water source.

To further ascertain the relationship between gender and access to water, a binary logistic regression analysis was conducted. The result shows that there is a statistically significant relationship between gender and access to water. The odds ratio indicates female-headed households are more likely to used water from improved water sources than their male counterparts. This finding implies that male-headed households are more likely to used water from unimproved water sources. The result also confirms the study conducted by Sinyolo et al. (2018), who said that regarding using improved water resources in the household, women are more efficient compared to men. The result also affirms the study conducted by Adam et al. (2016), in which they found that female household heads are more likely than male household heads to have access to improved water sources. This result indicates that the gender of a household head influences the choice of water source used in the household. The results is an indication that the economic strength of woman in South Africa is increasing, the poverty level of women is decreasing and they are now able to provide basic amenities such as water for themselves. Another possible reason is women are more particular about hygiene, compared to men.

Research question: What is the relationship between the source of income of the household head and access to potable water within a household?

Hypothesis: There is a relationship between households' sources of income and access to improved water sources.

Given the importance of income on access to potable water, this study examines the impact of access to water across household head income sources. To examine the influence of a household's income source on access to water, the study performed a cross-tabulation analysis between sources of income and access to water. According to the findings in the preceding chapter (See Table 4.9), the majority of household heads with income from pensions and other income sources, such as rental income and interest, have the highest level of access to piped water in the premises. Households with no income source have the least access to piped water in their premises. The results also suggest that households with no income source have the highest access to water from other improved water sources such as communal taps and neighbours' taps. The findings suggest that having sources of income will increase access to piped water in the premises, while not having a source of income does not imply having access to an unimproved water source. Household heads who receive grants and remittances are seen to have the highest level of access to an unimproved water source. The chi-square test for association between access to water and household head income sources shows that there is a statistically significant relationship between access to water and household heads' income sources. The phi and Cramer's V test shows that the association between households' access to water and income sources is moderate.

The logistics regression results show that there is a statistically significant relationship between income source and access to water, which implies that income source is a significant predictor of households' access to potable water. Furthermore, the odd ratio indicates that households with income from salaries/wages/commission are more likely to use water from an improved water source, compared to household heads with income from other sources (see Table 4.26). This result supports the finding of Dungumaro (2007), most especially the findings from the descriptive analysis. While stating that the source of household income influences access to safe water, the findings also show that householders with income from salaries and wages as their primary source of income collect their water from a piped tap in their home, a piped tap on-site, or a neighbour's tap; on the other hand, household heads with an income source from remittances rely primarily on public taps and households without an income source rely primarily on on-site piped taps.

Income, according to studies, is a key determinant of households’ access to potable water since it helps to control several aspects within the household. Given the significance of income, this research explores the influence of householders’ monthly income on access to potable water. The following research question and hypothesis were developed to better understand the impact of income on access to water.

Research question: Does the monthly income of a household head influence access to potable water?

Hypothesis: The monthly income of the household head influences access to potable water.

Monthly household income was divided into four categories to answer the research question: no monthly income, low monthly income, moderate monthly income and high monthly income, and water access was divided into three categories: piped water in the premises, other improved water sources, and unimproved water sources. First, a cross-tabulation study was performed between the household's main source of water and the monthly income of the householder. The findings show that households with a high income have access to piped water in their premises, followed by households with a moderate income. Households with no monthly income have higher access to piped water in their premises than low income households. Similarly, the majority of no-income households have the highest level of access to other improved water sources, while low-income households have the highest level of access to unimproved water sources. This suggests that households with a high monthly income are more likely to have access to piped water in their premises; however, having no monthly income does not reflect a lack of access to potable water.

The chi-square test findings show that there is a statistically significant association between access to water and a household's monthly income. The lambda, phi, and Cramer's V tests were performed to assess the strength of the association that exists between these two variables, and the results suggest that there is a strong relationship between access to water and the monthly income of a household head.

To confirm or refute the stated hypothesis, a binary logistic regression was performed and the results show that there is a statistical significant relationship between access to water and a household head's income source. According to the findings, household income is a strong predictor of access to potable water. The odd ratio revealed that a household head with no monthly income is less likely to have access to improved water. This implies that the monthly income of a household has an influence on access to potable water. This indicates that the stated hypothesis is true. This report is consistent with the findings of Fotue (2013) and Koskei et al. (2013), who argue in their studies that water affordability is closely related to household socioeconomic status (income), implying that a lack of or insufficient household income may lead households to rely on unimproved water sources for household purposes.

Research question: Is there a relationship between the level of education of a household head and access to potable water?

Hypothesis: There is a relationship between the level of education of a household head and access to an improved water source.

The influence of the household head's educational level was studied with regard to access to potable water. As indicated in the preceding chapter, household heads' education is a key determinant of a household's access to potable water because water and education are intricately intertwined. The above research question and hypothesis was formulated with the aim of understanding the influence and relationship between access to water and a householder's level of education. The Stats S.A. 2018 General Household Survey dataset was used to address the research question. The level of education of household heads was classified into five groups and a descriptive statistical analysis was performed. The results suggest that the majority of household heads have a college degree and just a small proportion of household heads have a postgraduate degree. The main source of potable water was also cross-tabulated with the level of education of the household head. According to the statistics, households with schooling/education have the highest level of piped water in their premises when compared to households without education. The majority of household heads with no education have access to other improved and unimproved water sources (see Figure 4.8). This finding is consistent with the findings of Kitamura et al. (2014), which suggest that water affects education and that access to safe potable water requires only a minimal level of education. A chi-square test for association shows that there is a statistically significant relationship between access to water and the household head's highest level of education (see Table 4.8).

To further confirm or refute the stated hypothesis, a logistics regression analysis was conducted. In this case, access to water was grouped into two dichotomous variables namely: improved and unimproved water source. Using 0.05 as a test statistic the results (see Table 4.26) show that the education level of household heads is a statistically significant determinant that can be used to predict a household's access to potable water. Using primary school as the reference group, the odd ratio reveals that householders with a college, certificate/degree, or postgraduate degree are more likely to use improved water than those with a primary school qualification. The findings also show that households with no schooling are more likely to access unimproved water than households with a primary education. The findings support the findings of Koskei et al. (2013) and Adams et al. (2016), who argue that education of the household head is a significant factor that influences the type of water source used by the household and that well-educated households have better access to potable water. Furthermore, the findings supported a South African study conducted by Bruce and Tamlyn (2018), which found that the education level of the household head was proportionate to access to piped water.

Research question: Does the population group of a household head affect access to potable water?

Hypothesis: Access to potable water sources is associated with the population group of the household head.

As previously indicated, South Africa has a unique history in which some population groups were restrained, resulting in deprivation and unequal distribution of basic services, particularly access to water. Hence this study explore access to water across household head's population groups. The above research question and hypothesis was formulated to understand the impact of population group on access to water. There are four different population groups in South Africa. These groups were cross-tabulated with access to water (households' main source of potable water). The findings shows that more Black/African household heads lack access to piped water in their premises compared to Coloured, White and Indian/Asian household heads. Also, the majority of Black/African householders are seen to have access to other improved water and unimproved water source (See Figure 4.5).

The chi-square test was used to establish the association between the main source of potable water and the population group of the household head and the findings show that there is a statistically significant association between access to water and the population group of the household head. The phi and Cramer's V results show a strong and moderate association between the two variables (See Table 4.5). The chi-square result confirms the hypothesis, *access to potable water sources is associated with the population group of household head*. Furthermore, the logistic regression analysis in the preceding chapter (see Table 4.26) shows that the population group of the household head is a significant predictor of a household's access to water. The odd ratio shows that Coloured and Indian/Asian household heads are more likely to use water from an improved source, compared to Black/African household heads. Contrary to what is expected from the study, the binary logistic regression indicates that the White household head have lesser chances of accessing an improve water source than Black/African household heads. The study's logistics regression analysis shows that Black/African household heads have more access to improved water than White-headed households. The logistics regression contradict the study's descriptive analysis which shows that White household have the highest access to piped water in premises. This discrepancy could be due to the study's classification of improved water. On the other hand, urbanisation, or the movement of people from rural to urban areas, is likely to increase Black household heads' chances of having better access to water. However, the hypothesis "access to potable water sources is associated with the population group of the household head" is true.

Research question: Is there an association between distance to water and the gender of household head?

Hypothesis: There is an association between the distance to water and the gender of the household head.

As research in the preceding chapter revealed that people walk long distances to collect water for the household, this study formulated the above research question and hypothesis with the aim of exploring the association between distance to water source and gender of household head. To understand the association between the distance travelled to a water source and the gender of a household head, a descriptive analysis was performed and the results show that the majority of male household heads walk less than 200 metre to source water, compared to female household heads. Using 200m as a proxy for having access to water, this means that male-headed households have better access to water than female-headed households. On the other hand, the result shows that more females walk longer distances to source water for the household (see Table 4.13). To clarify the impact of distance travelled to a water source, the mean average distance was computed across the gender of the household head (see Table 4.20). The result shows that male household heads travel a distance of an average of 0.321km, compared to female household heads who travel 0.345km, on average, to collect water.

The chi-square test was used to confirm or refute the stated hypothesis and the results show that there is a statistically significant association between gender of householder and distance of water source from the dwelling. The lambda, phi and Cramer's V tests findings show a weak association between the distance to a water source from the dwelling and the gender of the household head (see Table 4.14). This test confirms the hypothesis that there is a significant association between the distance to a water source and the gender of a household head. The one-way ANOVA test also shows that there is a statistically significant difference between the distance travelled to a water source and the gender of the household head. These results are consistent with Majuru et al. (2012) who indicated that the actual round-trip distance to water points, particularly in rural areas of South Africa, can be 600 meters or more.

5.6 Households' Perception of Water Quality by Household Socioeconomic Determinants

The quality of the water consumed by households can be determined in a variety of ways. The physical properties of water constitute the criteria most often used as a method households use to assess water quality. These physical characteristics, colour, taste, and odour of water assist households in assessing or evaluating the satisfactory level of potable water use in their households. To achieve the study's objective of examining consumers' perceptions of potable water and the socioeconomic determinants that influence perception of water quality, an in-depth investigation was conducted using the Stats S.A. 2018 General Household Survey data, and household indicators such as age, monthly income, and province of residence were considered and cross-tabulated with the recorded physical water properties. A logistical regression analysis was further performed to examine the relationship between perception of water quality and a household's socioeconomic determinants. The specific research question and research hypotheses are discussed in subsequent sections.

Research question: Does the province of residence and geographical settlement area influence households' perception of water quality?

Hypothesis: The province of residence and geographical settlement area influence a household's perception of water quality.

The aim of the above research question is to understand if a household head's province of residence or geographical settlement area has an impact in their perception of water quality. To answer this research question, the perception of water quality (safety, colour, taste and odour) was first cross-tabulated with the household head's province of residence. The findings (see Table 4.16) show that across the different provinces of residence, the majority of householders are satisfied with the quality of their main source of potable; only a small proportion of householders are see dissatisfied with the quality of their water. The findings also show that provinces such as the Western Cape with a high level of access to water are mainly concerned about the taste and safety of their water, while provinces such as Mpumalanga and KwaZulu-Natal, with a high level of access to unimproved water sources, are found to be more dissatisfied with the quality of their main source of water. This implies that having access to improved water increases the level of satisfaction with the water quality, while having poor access to water increases the level of dissatisfaction with the quality of water.

To test the hypothesis, a logistic regression analysis was conducted. The different perceptions of water quality (safety, colour, taste and odour) were coded into binary variables and the findings (see Table 4.28) show that province of residence is a significant predictor of a household's perception of water quality. The odd ratio shows that householders in the Western Cape are more like to be satisfied with the safety and clarity of their water, compared to other provinces. Householders in Mpumalanga are more likely to be satisfied with taste and odour of their potable water, compared to other provinces. This result confirms the above hypothesis that householders' province of residence influences the perception of water quality.

The perception of water quality was further examined across geographical settlement (metropolitan area). The result shows that water quality perception is relatively high across metro and non-metro area of settlement. For both settlement areas, the highest level of dissatisfactions in the households' main source of potable was found in the water taste. The results in Table 4.16 show that households in the metro area are less satisfied with the safety, taste, smell and colour of the households' main source of potable. In addition, the logistic regression result shows that households' area of settlement is a significant predictor of water safety, taste and clarity. For water odour, the binary logistics regression shows the odour of water is not a significant predictor of water quality perception. Finally, the odd ratio shows that in non-metro areas, households are more likely to perceive that their main source of water is safe and clear for household use. On the other hand, households in the metro areas are more likely to perceive that the water quality of household main source of water taste is good and is free from odour. The results confirm the hypothesis that household heads' geographical area of settlement influences their perceptions of water quality.

Research question: Does the age of the household head influence their perception of water quality?

Hypothesis: There is a relationship between the age of a household head and their perceptions of water quality.

The age of household head was explored to understand the impact it has on a household's perception of water quality. A descriptive analysis was conducted and the findings (see Table 4.18) indicate that the majority of household heads across each age group are highly satisfied with the quality of their main source of potable water. However, there is some notable dissatisfaction that can be seen across the household heads' ages. The highest level of dissatisfaction is seen from household heads age 57 and above. They are less satisfied with the safety, taste, odour and clarity of their main source of water, compared to household heads of ages 12-56. This result corroborates the findings of access to water across household age groups because, from the results (see Figure 4.3), household heads age 57 and above are seen to have a high level of access to improved water. This could account for the reason why the level of dissatisfaction of water quality is high.

The findings from the logistic regression analysis (see Table 4.26) show that household heads' age is a good predictor of water safety and that there is a statistically significant relationship between the age of a household head and their perception of water quality. The odd ratio shows that household heads age 12-56 are more like to be satisfied with the safety of their potable water. The findings shows that age is a significant predictor of household water clarity. The odd ratio shows that householders aged 12-71 are more likely to be satisfied with the clarity of their potable water. The findings also show that the age group 12-

26 is not a significant predictor of their perception of the taste of water, however the odd ratio shows that householders aged 12-41 are more likely to be satisfied with taste of their potable water compared to other age groups. Lastly, except for age group 57-71, all other age groups are seen to be significant predictors of water odour. The odd ratio further shows the age group 12-41 is more likely to be satisfied with the odour of their potable water. This result corroborates the result findings of the descriptive analysis and older household heads having a high level of dissatisfaction. The findings also support the study research hypothesis that there is a relationship between the age of a household head and their perceptions of water quality

Research question: Is there an association between a household head's monthly income and their perception of water quality?

Hypothesis: There is a relationship between the monthly income of a household head and their perceptions of water quality.

In the water sector, income has been seen to play a very significant role. Hence, the impact of a householder's monthly income on their perception of water quality was explored. The descriptive analysis of a householder's monthly income and their perception of water quality shows that householders with no monthly income are more satisfied with the safety of their water, followed by low-income, moderate- and high-income earners. In general, the water quality satisfaction level is high across all income groups, except for some notable dissatisfaction with water quality. Ordinarily, one would expect that households with no income would have more concern about the safety of the main potable water, however, the result shows the reverse.

The logistic regression analysis shows that monthly income is a good predictor of household perception of water quality (see Table 4.28). The odds ratio shows that household heads with no monthly income are more likely to be satisfied with the safety of their water, compared to other income groups. However, householders with no income are seen to be less satisfied with the clarity, taste and odour of their potable water, compared to householders with a monthly income. This is an indication that households with no income depend on unimproved water sources, hence the high level of dissatisfaction with the taste, odour and clarity. Also, because unimproved water sources are their main source of water, households with no income consider it to be their safest source hence the reason for a high level of satisfaction with their water's safety. The result confirms the results in the descriptive analysis. These results on households' perception of water does not corroborate the findings from Wright et al. (2012), a research on the public understanding of the quality of drinking water in South Africa in the years 2002 to 2009. Even so, findings indicate that perceived drinking water quality has remained fairly constant and high over time in South Africa. The findings noted that perceived drinking water quality is mainly linked to the taste, odour, and clarity of the water. However, household socioeconomic or demographic characteristics such as household heads' ethnic group, household head monthly expenditure, and education are not significant in terms of a household head's perceptions of water quality (Wright et al., 2012). In the next section, all hypotheses under study are confirmed or refuted.

5.7 Confirmation of Hypothesis

In this section, emphasis will be made on hypotheses that were confirmed or rejected. Using the statistical methods that were mentioned in the preceding chapter to answer the research questions in Chapter One of the study, the results and findings show that not all the tested hypothesis were confirmed.

Hypothesis 1: Households headed by females are less likely to have access to improved water sources.

Hypothesis one was tested using the logistic regression model. The results from the analysis show that the hypothesis stated above was not confirmed because the outcome from the results show that households headed by females are more likely to use improved water sources in South Africa. The conclusion from the results is that male household heads, instead of females, are less likely to access potable water.

Hypothesis 2: There is a relationship between households' sources of income and access to improved water sources.

The relationship between householders' sources of income and access to improved water sources was tested using a chi-square test of association and a logistic regression model. The results from this study indicate that the stated hypothesis is confirmed. It was confirmed because both the descriptive analysis and chi-square test show that a household head with an income source is more likely to access improved water and there is a significant relationship between income source and access. The logistic regression further confirms the result from chi-square test.

Hypothesis 3: The monthly income of the household head influences access to potable water.

A descriptive analysis, chi-square association test, and a binary logistic regression model were used to verify hypothesis three. The results indicate that the stated hypothesis is confirmed. The descriptive results show that households with a monthly income will utilise a potable water source more than households with no monthly income. The chi-square test and the binary logistic regression also show a relation between the monthly income of the household head and access to potable water. Finally, the binary logistic regression indicates that household heads with a monthly income are more likely to use improved water sources than households with no monthly income.

Hypothesis 4: There is a relationship between the level of education of a household head and access to an improved water source.

The educational level of a householder was examined using the descriptive method of analysis, a chi-square test and logistic regression. The results show that householders with high level of education will have better access to improved water and that there is a significant relationship between a householder's educational level and access to potable water. Hence, the hypothesis that there is a relationship between the level of education of a household head and access to improved water source was confirmed.

Hypothesis 5: Access to potable water sources is associated with the population group of the household head

The fourth hypothesis, access to potable water sources is associated with the population group of household head, was confirmed. The descriptive statistics show that access to water varies across population group. Indian/Asian household heads are seen to have better access to an improved water source. The chi-square results indicate that there is a relationship between the population group of a householder and access to water. The logistic regression was also in agreement with the chi-square test. The results shows the Indian/Asian household heads are more likely to access potable water than other population groups in South Africa and a population group is a significant predictor of a household's access to water.

Hypothesis 6: There is an association between the distance to water and the gender of the household head.

In determining the association between the distance to water and the gender of the household head, descriptive analysis, a chi-square test, and a one-way ANOVA were used and the hypothesis was confirmed. The results show that in South Africa, female householders walk longer distances to collect water for the household and there is a significant relationship between the distance to water and the gender of the household head.

Hypothesis 7: The province of residence and geographical settlement area influences a household's perception of water quality.

To ascertain the influence a householder's province of residence has on the household's perception of water quality, a descriptive and logistics regression analysis were performed. The findings show that the perception of water quality across South Africa provinces is relatively high and that the province of residence influences the household's perception of the safety, taste, clarity and odour of the household's main source of potable water. Hence, the stated hypothesis was confirmed. Similarly, a logistics regression analysis was performed in terms of geographical settlement area and the findings show that households in non-metro areas of settlement are more likely to perceive that the household's main source potable water is clear and safe to consume. On the other hand, households in a metro area are more likely to perceive that the taste and smell of household main source of potable is good.

Hypothesis 8: There is a relationship between the age of a household head and their perceptions of water quality.

The relationship between the age of a householder and their perception of water quality was tested and the hypothesis was confirmed. However, for some age groups, the result also indicates that they are not significant in predicting households' perception of water.

Hypothesis 9: There is a relationship between the monthly income of a household head and their perceptions of water quality.

The hypothesis that there is a relationship between the monthly income of a household head and their perceptions of water quality was confirmed in the study. Using a logistic regression model, the result shows that there is a significant relationship between the monthly income of household head and their perceptions of water quality. Householders with a monthly income are more likely to perceive that their main source of potable water is clear, tastes good and is free of odour. For water safety perception, the result shows that household heads with monthly income are less likely to perceive their household water quality as safe, compared to household heads with monthly income.

5.8 Conclusion

The study looked at the variables of access to water and perceptions of water quality among South African households. According to the report, there are differences in the level of access to water among provinces and geographical settlement areas. It was also shown that there is a significant relationship between water access and household socioeconomic variables. Using the Stats S.A. 2018 General Household Survey data, it was found that gender, age, income, and income source are indeed determinants that can limit households from having access to potable water. Furthermore, the research reveals that household socioeconomic determinants influence perception of water quality.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

The study's objective was to investigate the socioeconomic aspects of South African households that influence access to water and households' perceptions of water quality. To achieve the objectives, the Stats S.A. 2018 General Household Survey data set was used with the goal of identifying household socioeconomic determinants that hinder or enable households to access potable water, influence the choice of water source used in the household, and households' perceptions of water quality, as well as the socioeconomic determinants that influence how households perceive their potable water in terms of water safety, taste, clarity, and odour. In the study, the household head was used as the unit of observation since it is the most fundamental social unit for resource pooling and sharing, and household head characteristics such as gender, age, educational level, income, and demographic group were used to address the objectives, research questions, and hypotheses outlined in Chapter One of this study. A statistical software program (SPSS) was used to analyse the collected data. Descriptive analyses, frequencies, percentages, and cross tabulations were used to present the data. ANOVA and logistic regression models were also used in the study to understand the level of inequality in access to water. This chapter is organised as follows: summary of key findings, general conclusion, recommendations, and suggestions for further research.

6.2 Summary of Key Findings

The summary of the findings in this section has been organised into themes based on the study's objectives.

6.2.1 Socioeconomic characteristics of the household

As mentioned in the preceding chapters, household characteristics were identified based on literature reviews. According to these descriptive statistics, the majority of household heads are male (56.9 %). Of this majority of household heads, 35% are between the ages of 42 and 56. Eighty-three per cent are Black/African, and 64.5 % live in formal-urban areas. The majority of household heads are high-income earners, with the majority of their income coming from salaries/wages/commissions (53.3%). More than two-thirds (61.9%) of household heads have a college degree. The description of household characteristics provides a depiction of all households in South Africa.

6.2.2 The available sources and preferred water sources in South Africa.

The available source of potable water for households in South Africa include piped (tap) water in dwellings, piped (tap) water on site or in the yard, borehole on site, rain-water tank on site, neighbour's tap, public/communal tap, watercarrier/tanker, water vendor, borehole outside yard, flowing water/stream/river, stagnant water/dam/pool, well and spring. These water sources were subdivided into three categories: piped water in the premises, other improved water and unimproved water. The findings shows that 48% have piped water in the premises, while 43% have improved water that is not within the household and less than 10% access an unimproved water source. These results suggest that piped water in the premises is the most preferred or accessible water source in South Africa. Furthermore, socioeconomic determinants such as age, income, education, gender, place of residence and income source show that households’ choice of water is based on their socioeconomic characteristics. For instance, the findings show that male household heads have more access to piped water in the premises, more specifically, males aged 27 and above have more access to piped water in the premises than females within same age range. The majority of Indian/Asian and White household heads have piped water in the premises compared to Black/African households. The findings also suggest that the majority of households residing in a more developed province and in formal-urban areas have access to piped water in premises. Post-graduate and high-income earners also have more access to piped water in the premises. These are indications that show that household access to water and preferred source choices are based on socioeconomic characteristics. These household socioeconomic characteristics are seen as a barrier that limit and enable households to access potable water sources.

6.2.3 Socioeconomic determinants influencing access to water

As indicated in the literature and most especially the conceptual framework of the study, access to potable water is influenced by household socioeconomic determinants. Eight socioeconomic determinants were examined, and they include: gender, age, education, income, income source, province, geographical settlement area and population group of the household head. The findings show that there is association between access to water and these socioeconomic determinants. Also, in South Africa all of these variables influence access to potable water. Using the logistic regression model in predicting and finding the relationship between these socioeconomic variables and access to water, water access types (sources of water) were coded into binary variables. The findings show that the gender of the household head is a significant predictor of access to potable water, and female householders are more likely to use water from an improved water source than male householders. The householder's province of residence is a significant determinant, and households in the Western Cape are more likely to use an improved water source compared to other provinces. Householders living in the formal urban areas are more likely to use an improved water source, compared to householders living in the traditional and farm settlement areas. In terms of population groups, the Indian/Asian group are more likely to use an improved water source, compared to other population groups. The age of a householder is also seen as a determinant that influences access to potable water. Householders aged 72 and above are found to be more likely to access potable water. Furthermore, education, monthly income and income sources are significant determinants that influence a household's access to potable water. The findings show that householders with a post-graduate degree, householders with no monthly income, and householders with salaries/wages/commission as a source of income are more likely to use an improved water source. The results serve an indication that socioeconomic determinants influence a householder's access to potable water in South Africa.

6.3 Socioeconomic Determinants Influencing Households' Perception of Water Quality

The study examined households' perceptions of water quality with regard to water safety, taste, clarity, and odour. The aim was to understand the level of households' satisfaction with water quality and to investigate the socioeconomic determinants that influence households' perception of water quality. The socioeconomic determinants investigated were gender, age, province of residence, and monthly income. The results show that across provinces, householders are generally satisfied with the safety, taste, odour, and clarity of their main source of water. However, the levels of satisfaction across these provinces are unequal. For instance, the Western Cape and Gauteng have higher levels of satisfaction with their water quality compared to the Eastern Cape and Free State. The results also show that householders across the different age groups are highly satisfied with the safety, taste, clarity, and odour of their main source of potable water. Across each age group, household dissatisfaction was mainly about the taste of their main source of potable water. Also, across householders' income, the water quality satisfaction is considerably high. However, households with an income seem to have the highest level of dissatisfaction.

These household socioeconomic determinants were further investigated to understand if they influence the householder's perception of water quality. The results show that the gender of a household head is significant in predicting water quality with regard to safety, taste, clarity, and odour. Female householders are more likely to perceive their potable water as safe to drink, good in taste, clear and odour free, compared to male householders. Householders residing in the Western Cape are more likely to perceive the safety, taste, clarity, and odour of their potable water as good compared to other provinces. On the other hand, householders residing in Mpumalanga province are more likely to perceive the taste and odour of their potable water as good compared to other provinces. Across the age groups of householders, those aged 57-71 are less likely to perceive the safety, taste, clarity, and odour of their potable water as good compared to other age groups. These results suggest that household socioeconomic characteristics influence households' perception of water quality.

6.4 Conclusion of Results

Based on the findings of the study, the following conclusions can be reached. The study found that for households to meet their domestic needs, they have to access one or more of the several sources of water available to them. The majority of households have access to piped water in the premises and other improved potable water, such as communal piped water. The study also found that only a small proportion of households access an unimproved water source. The study further found that determinants such gender, age, province of residence, geography type, income, educational level, and income source of household heads significantly influence access to potable water. The study also concludes that access to potable water differs across province of residence and geographical settlement area.

Furthermore, the study investigated households' perception of water quality and the socioeconomic determinants that influence households' perception of water quality with regard to water safety, taste, clarity, and odour. The study concludes that households are generally highly satisfied with the quality of their main source of potable water, and that household determinants such as gender, province of residence, age, and income of the household head influences their perception of water quality. The study also found that there is a link between access to water and perception of water quality. Householders residing in provinces with better access to water and good infrastructures are more satisfied with the quality of their main source of water because this source is mainly an improved water source. Also, households with an income source are more satisfied with the safety of their main source of water compared to households with no income.

6.5 Recommendations

Having looked at the socioeconomic determinants that influence water access and perception of water quality in South Africa, the study makes the following recommendations. Given that access to water differs across provinces, and province that are less developed are mostly affected, it is recommended that the national government should provide more funds to the local governments in affected provinces such as the Eastern Cape, Kwazulu-Natal, and Limpopo. This will help in the creation of new water infrastructures, in the repair of damaged water facilities, and in strengthening new strategies that can help in improving the water services, thereby increasing access to potable water in these provinces.

Providing adequate water to households is a way of reducing poverty within the country. It is recommended that water organisations should look at ways in which new water polices can be created and implemented. These polices should promote inclusive and sustainable human development and should consider households which are in marginalised area, women (as they are the main users of this resource) and low- or no-income households. Because the level of education of the household head has a significant influence on the type of water source used by the household, educating or providing basic education on the importance of access to safe potable water, particularly for rural and marginalised households, will have a tremendous beneficial effect on South African households, equipping them to fight poverty, manage water better, and increase the accuracy of their perception of water quality. There is also a need to financially empower women and equip them with better education in order to close the gender gap of inequality in access to water and achieve the Millennium Development Goals and sustainable development Goals.

6.6 Future Research

This study used the Stats S.A. 2018 General Household Survey data. However, some associated gaps were notice. The data set is secondary data, thus this study recommends that future work should be focused on the use of a primary data set and more focus should be on marginalised areas where access to water is low. This data set was unable to address issues such as the effect of urbanisation and scarcity. Therefore, future research should consider these areas while examining access to water. Finally, more socioeconomic variables that influence households' perception of water quality should be investigated, as research in this area is limited. Future studies should also take into consideration the impact of climate change on water supply and demand and the health implications of achieving the sustainable development goals in South Africa and elsewhere.

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APPENDICES

Appendix 1

HH Main Source of Water * Sex of Household Head Cross Tabulation* HH Age Group *					
Gender	**HH age group**	**HH main source of water**			**Total**
		Piped water in premises	**Other improved water sources**	**Unimproved water sources**	
Male	**12-26**	206088	510026	72340	788454
		26.1%	64.7%	9.2%	100.0%
	27-41	1067584	1463859	179570	2711013
		39.4%	54.0%	6.6%	100.0%
	42-56	1655064	1415518	240504	3311086
		50.0%	42.8%	7.3%	100.0%
	57-71	1149283	819298	200405	2168986
		53.0%	37.8%	9.2%	100.0%
	72+	253357	195855	53325	502537
		50.4%	39.0%	10.6%	100.0%
	Total	4331376	4404556	746144	9482076
		45.7%	46.5%	7.9%	100.0%
Female	**12-26**	118279	261367	62152	441798
		26.8%	59.2%	14.1%	100.0%
	27-41	510308	823664	131632	1465604
		34.8%	56.2%	9.0%	100.0%
	42-56	1058508	1223940	233667	2516115
		42.1%	48.6%	9.3%	100.0%
	57-71	857892	946538	200117	2004547
		42.8%	47.2%	10.0%	100.0%
	72+	275033	390654	95027	760714
		36.2%	51.4%	12.5%	100.0%
	Total	2820020	3646163	722595	7188778
		39.2%	50.7%	10.1%	100.0%
Total	**12-26**	324367	771393	134492	1230252
		26.4%	62.7%	10.9%	100.0%
	27-41	1577892	2287523	311202	4176617
		37.8%	54.8%	7.5%	100.0%
	42-56	2713572	2639458	474171	5827201
		46.6%	45.3%	8.1%	100.0%
	57-71	2007175	1765836	400522	4173533
		48.1%	42.3%	9.6%	100.0%
	72+	528390	586509	148352	1263251
		41.8%	46.4%	11.7%	100.0%
	Total	7151396	8050719	1468739	16670854
		42.9%	48.3%	8.8%	100.0%

Appendix 2

Distance of Water Source from the Dwelling * Population Group of Household Head Sex of Household Head Cross Tabulation						
Gender	**Distance of water source**	**Population group of household head**				**South Africa**
		Black/ African	**Coloured**	**Indian/Asian**	**White**	
Male	**Less than 200 metres**	1009468	14346	1464	16299	1041577
		58.3%	82.2%	100.0%	68.1%	58.7%
	201-500 metres	472331	794	0	0	473125
		27.3%	4.5%	0.0%	0.0%	26.7%
	501m-1 kilometre	159573	0	0	3337	162910
		9.2%	0.0%	0.0%	13.9%	9.2%
	More than 1 kilometre	90034	2320	0	4301	96655
		5.2%	13.3%	0.0%	18.0%	5.4%
	Total	1731406	17460	1464	23937	1774267
		100.0%	100.0%	100.0%	100.0%	100.0%
Female	**Less than 200 metres**	908304	19212	4188	5015	936719
		50.4%	84.1%	100.0%	67.9%	51.0%
	201-500 metres	581545	1127	0	1341	584013
		32.3%	4.9%	0.0%	18.2%	31.8%
	501m-1 kilometre	236844	1119	0	1031	238994
		13.1%	4.9%	0.0%	14.0%	13.0%
	More than 1 kilometre	75585	1385	0	0	76970
		4.2%	6.1%	0.0%	0.0%	4.2%
	Total	1802278	22843	4188	7387	1836696
		100.0%	100.0%	100.0%	100.0%	100.0%
Total	**Less than 200 metres**	1917772	33558	5652	21314	1978296
		54.3%	83.3%	100.0%	68.0%	54.8%
	201-500 metres	1053876	1921	0	1341	1057138
		29.8%	4.8%	0.0%	4.3%	29.3%
	501m-1 kilometre	396417	1119	0	4368	401904
		11.2%	2.8%	0.0%	13.9%	11.1%
	More than 1 kilometre	165619	3705	0	4301	173625
		4.7%	9.2%	0.0%	13.7%	4.8%
	Total	3533684	40303	5652	31324	3610963
		100.0%	100.0%	100.0%	100.0%	100.0%

Appendix 3

Main source of drinking water	Water safety		Water taste		Water clarity		Water odour	
	NO	YES	NO	YES	NO	YES	NO	YES
Piped (tap) water in dwelling	483213 (36.7%)	6668183 43.4%	548611 35.9%	6602785 43.6%	481035 36.6%	6670361 43.4%	450785 36.2%	6700611 43.4%
Piped (tap) water on site or in yard	254328 19.3%	4532621 29.5%	308494 20.2%	4478455 29.6%	316031 24.0%	4470918 29.1%	264019 21.2%	4522930 29.3%
Borehole on site	13643 1.0%	396888 2.6%	48747 3.2%	361784 2.4%	18161 1.4%	392370 2.6%	19978 1.6%	390553 2.5%
Rain-water tank on site	4487 0.3%	275998 1.8%	6110 0.4%	274375 1.8%	3737 0.3%	276749 1.8%	8018 0.6%	272467 1.8%
Neighbour's tap	12861 1.0%	309601 2.0%	25671 1.7%	296791 2.0%	18540 1.4%	303922 2.0%	8749 0.7%	313713 2.0%
Public/ communal tap	65971 5.0%	2184319 14.2%	119594 7.8%	2130697 14.1%	82587 6.3%	2167704 14.1%	125890 10.1%	2124400 13.8%
Water-carrier/ tanker	40066 3.0%	256167 1.7%	50275 3.3%	245958 1.6%	43861 3.3%	252372 1.6%	42840 3.4%	253393 1.6%
Water vendor	14792 1.1%	213105 1.4%	29870 2.0%	198027 1.3%	12604 1.0%	215293 1.4%	6309 0.5%	221588 1.4%
Borehole outside yard	48673 3.7%	251424 1.6%	75359 4.9%	224738 1.5%	31209 2.4%	268888 1.8%	35089 2.8%	265008 1.7%
Flowing water/ stream/river	275332 20.9%	89226 0.6%	242933 15.9%	121625 0.8%	222566 16.9%	141993 0.9%	207822 16.7%	156736 1.0%
Stagnant water/ dam/pool	17122 1.3%	10547 0.1%	17657 1.2%	10011 0.1%	18636 1.4%	9032 0.1%	17657 1.4%	10011 0.1%
Well	23341 1.8%	25159 0.2%	17325 1.1%	31175 0.2%	19667 1.5%	28833 0.2%	15080 1.2%	33420 0.2%
Spring	59111 4.5%	74362 0.5%	32404 2.1%	101069 0.7%	41431 3.2%	92042 0.6%	37714 3.0%	95759 0.6%
Other	3793 0.3%	66520 0.4%	5156 0.3%	65157 0.4%	4293 0.3%	66020 0.4%	5551 0.4%	64762 0.4%
Total	1316733 100.0%	15354120 100.0%	1528206 100.0%	15142647 100.0%	1314358 100.0%	15356497 100.0%	1245501 100.0 %	15425351 100.0%

Appendix 4

Multiple Comparisons						
Dependent variable: Distance of water source from the dwelling						
Tukey HSD						
(I) HH level of education	(J) HH level of education	Mean difference (I-J)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
No schooling	**Primary**	.123*	.001	<,001	.12	.13
	College	.294*	.001	<,001	.29	.30
	Cert/diploma	.213*	.003	<,001	.21	.22
	Degrees	.055*	.006	<,001	.04	.07
	Post-graduates	.162*	.009	<,001	.14	.19
Primary	**No schooling**	-.123*	.001	<,001	-.13	-.12
	College	.171*	.001	<,001	.17	.17
	Cert/diploma	.090*	.003	<,001	.08	.10
	Degrees	-.068*	.006	<,001	-.08	-.05
	Post-graduates	.039*	.009	<,001	.01	.06
College	**No schooling**	-.294*	.001	<,001	-.30	-.29
	Primary	-.171*	.001	<,001	-.17	-.17
	Cert/diploma	-.081*	.003	<,001	-.09	-.07
	Degrees	-.240*	.006	<,001	-.26	-.22
	Post-graduates	-.132*	.009	<,001	-.16	-.11
Cert/ diploma	**No schooling**	-.213*	.003	<,001	-.22	-.21
	Primary	-.090*	.003	<,001	-.10	-.08
	College	.081*	.003	<,001	.07	.09
	Degrees	-.159*	.006	<,001	-.18	-.14
	Post-graduates	-.051*	.009	<,001	-.08	-.03
Degrees	**No schooling**	-.055*	.006	<,001	-.07	-.04
	Primary	.068*	.006	<,001	.05	.08
	College	.240*	.006	<,001	.22	.26
	Cert/diploma	.159*	.006	<,001	.14	.18
	Post-graduates	.107*	.010	<,001	.08	.14

Post-graduates	**No schooling**	-.162*	.009	<,001	-.19	-.14
	Primary	-.039*	.009	<,001	-.06	-.01
	College	.132*	.009	<,001	.11	.16
	Cert/diploma	.051*	.009	<,001	.03	.08
	Degrees	-.107*	.010	<,001	-.14	-.08

*. The mean difference is significant at the 0.05 level.

Appendix 5

Multiple Comparisons						
Dependent Variable: Distance of water source from the dwelling						
Tukey HSD						
(I) South African provinces	(J) South African provinces	Mean difference (I-J)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
Western Cape	Eastern Cape	-.403*	.002	<,001	-.41	-.40
	Northern Cape	-.112*	.003	<,001	-.12	-.10
	Free State	-.192*	.004	<,001	-.20	-.18
	KwaZulu-Natal	-.987*	.002	<,001	-.99	-.98
	North West	-.413*	.003	<,001	-.42	-.40
	Gauteng	-.070*	.003	<,001	-.08	-.06
	Mpumalanga	-.378*	.003	<,001	-.39	-.37
	Limpopo	-.595*	.002	<,001	-.60	-.59
Eastern Cape	Western Cape	.403*	.002	<,001	.40	.41
	Northern Cape	.291*	.003	<,001	.28	.30
	Free State	.211*	.003	<,001	.20	.22
	KwaZulu-Natal	-.584*	.001	<,001	-.59	-.58
	North West	-.010*	.002	<,001	-.01	.00
	Gauteng	.332*	.002	<,001	.33	.34
	Mpumalanga	.024*	.002	<,001	.02	.03
	Limpopo	-.192*	.001	<,001	-.20	-.19
Northern Cape	Western Cape	.112*	.003	<,001	.10	.12
	Eastern Cape	-.291*	.003	<,001	-.30	-.28
	Free State	-.081*	.004	<,001	-.09	-.07
	KwaZulu-Natal	-.875*	.003	<,001	-.88	-.87
	North West	-.301*	.003	<,001	-.31	-.29
	Gauteng	.041*	.003	<,001	.03	.05
	Mpumalanga	-.267*	.003	<,001	-.28	-.26
	Limpopo	-.483*	.003	<,001	-.49	-.47
Free State	Western Cape	.192*	.004	<,001	.18	.20
	Eastern Cape	-.211*	.003	<,001	-.22	-.20
	Northern Cape	.081*	.004	<,001	.07	.09
	KwaZulu-Natal	-.795*	.003	<,001	-.80	-.79
	North West	-.221*	.003	<,001	-.23	-.21
	Gauteng	.122*	.003	<,001	.11	.13
	Mpumalanga	-.186*	.003	<,001	-.20	-.18
	Limpopo	-.402*	.003	<,001	-.41	-.39

KwaZulu-Natal	**Western Cape**	.987*	.002	<,001	.98	.99
	Eastern Cape	.584*	.001	<,001	.58	.59
	Northern Cape	.875*	.003	<,001	.87	.88
	Free State	.795*	.003	<,001	.79	.80
	North West	.574*	.002	<,001	.57	.58
	Gauteng	.916*	.002	<,001	.91	.92
	Mpumalanga	.608*	.002	<,001	.60	.61
	Limpopo	.392*	.001	<,001	.39	.40
North West	**Western Cape**	.413*	.003	<,001	.40	.42
	Eastern Cape	.010*	.002	<,001	.00	.01
	Northern Cape	.301*	.003	<,001	.29	.31
	Free State	.221*	.003	<,001	.21	.23
	KwaZulu-Natal	-.574*	.002	<,001	-.58	-.57
	Gauteng	.342*	.002	<,001	.34	.35
	Mpumalanga	.034*	.002	<,001	.03	.04
	Limpopo	-.182*	.002	<,001	-.19	-.18
Gauteng	**Western Cape**	.070*	.003	<,001	.06	.08
	Eastern Cape	-.332*	.002	<,001	-.34	-.33
	Northern Cape	-.041*	.003	<,001	-.05	-.03
	Free State	-.122*	.003	<,001	-.13	-.11
	KwaZulu-Natal	-.916*	.002	<,001	-.92	-.91
	North West	-.342*	.002	<,001	-.35	-.34
	Mpumalanga	-.308*	.002	<,001	-.32	-.30
	Limpopo	-.524*	.002	<,001	-.53	-.52
Mpumalanga	**Western Cape**	.378*	.003	<,001	.37	.39
	Eastern Cape	-.024*	.002	<,001	-.03	-.02
	Northern Cape	.267*	.003	<,001	.26	.28
	Free State	.186*	.003	<,001	.18	.20
	KwaZulu-Natal	-.608*	.002	<,001	-.61	-.60
	North West	-.034*	.002	<,001	-.04	-.03
	Gauteng	.308*	.002	<,001	.30	.32
	Limpopo	-.216*	.002	<,001	-.22	-.21
Limpopo	**Western Cape**	.595*	.002	<,001	.59	.60
	Eastern Cape	.192*	.001	<,001	.19	.20
	Northern Cape	.483*	.003	<,001	.47	.49
	Free State	.402*	.003	<,001	.39	.41
	KwaZulu-Natal	-.392*	.001	<,001	-.40	-.39
	North West	.182*	.002	<,001	.18	.19
	Gauteng	.524*	.002	<,001	.52	.53
	Mpumalanga	.216*	.002	<,001	.21	.22

*. The mean difference is significant at the 0.05 level.

Appendix 6

Variables in the Equation								
	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
Western Cape			131904.163	8	.000			
Eastern Cape	-2.376	.012	40286.374	1	.000	.093	.091	.095
Northern Cape	-.357	.014	609.472	1	.000	.699	.680	.720
Free State	-2.030	.012	26928.475	1	.000	.131	.128	.135
KwaZulu-Natal	-2.217	.012	35050.834	1	.000	.109	.106	.112
North West	-1.730	.012	20347.480	1	.000	.177	.173	.182
Gauteng	-1.749	.012	21028.567	1	.000	.174	.170	.178
Mpumalanga	-1.684	.012	19592.200	1	.000	.186	.181	.190
Limpopo	-1.890	.012	25138.558	1	.000	.151	.148	.155
Black/African			12001.404	3	.000			
Coloured	.381	.009	1826.952	1	.000	1.464	1.439	1.490
Indian/Asian	1.362	.022	3901.740	1	.000	3.902	3.739	4.073
White	-.460	.006	5405.770	1	.000	.632	.624	.639
Sex of household head(1)	.109	.002	3067.788	1	.000	1.115	1.111	1.120
Salaries/wages/ commission			29851.770	8	.000			
Income from a business	-.196	.004	2409.596	1	.000	.822	.815	.828
Remittances	-.015	.003	19.111	1	.000	.985	.979	.992
Pensions	-.153	.009	318.058	1	.000	.858	.844	.873
Grants (including old age grants)	-.405	.003	24087.759	1	.000	.667	.664	.670
Sales of farming products and services	-.122	.024	26.566	1	.000	.885	.845	.927
Other income sources e.g. rental income, interest	-.303	.011	761.107	1	.000	.739	.723	.755
No income	-.045	.010	19.331	1	.000	.956	.937	.975
Unspecified	-.353	.005	4755.201	1	.000	.703	.696	.710
Formal-urban			562320.544	2	.000			
Traditional	-2.050	.003	460217.056	1	.000	.129	.128	.130
Farms	-2.446	.004	399194.126	1	.000	.087	.086	.087
12-26			41930.626	4	.000			
27-41	-.771	.005	24018.285	1	.000	.463	.458	.467
42-56	-.687	.004	26736.846	1	.000	.503	.499	.507
57-71	-.479	.004	16001.346	1	.000	.620	.615	.624
72+	-.182	.004	2639.342	1	.000	.833	.828	.839

Primary school			69506.683	5	.000			
College	.413	.003	25915.871	1	.000	1.511	1.503	1.518
Cert/degree	.634	.005	18218.336	1	.000	1.885	1.868	1.903
Post-graduate degree	2.253	.020	12837.783	1	.000	9.519	9.155	9.898
No schooling	-.215	.003	4913.054	1	.000	.806	.802	.811
DNK and unspecified	-.302	.007	1701.062	1	.000	.739	.729	.750
No monthly income			8429.869	4	.000			
Low income	-.536	.026	427.306	1	.000	.585	.556	.616
Moderate income	-.631	.026	593.976	1	.000	.532	.506	.560
High income	-.770	.025	921.509	1	.000	.463	.441	.487
Unknown	-.954	.025	1449.980	1	.000	.385	.367	.404
Constant	6.681	.028	56587.598	1	.000	796.762		

a. Variable(s) entered on step 1: South African provinces, Population group of household head, Sex of household head, Income sources, Geography type, HH age group, HH level of education, Monthly income of HH.

Appendix 7

Variables in the Equation								
	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
Western Cape			187.955	8	.000			
Eastern Cape	-2.359	.316	55.850	1	.000	.095	.051	.176
Northern Cape	-.342	.389	.773	1	.379	.711	.332	1.522
Free State	-2.021	.331	37.270	1	.000	.133	.069	.254
KwaZulu-Natal	-2.212	.316	49.125	1	.000	.109	.059	.203
North West	-1.704	.324	27.644	1	.000	.182	.096	.343
Gauteng	-1.652	.323	26.191	1	.000	.192	.102	.361
Mpumalanga	-1.620	.322	25.356	1	.000	.198	.105	.372
Limpopo	-1.797	.318	31.898	1	.000	.166	.089	.309
Black/African			15.019	3	.002			
Coloured	.199	.239	.693	1	.405	1.221	.763	1.952
Indian/Asian	1.293	.587	4.857	1	.028	3.645	1.154	11.513
White	-.509	.175	8.488	1	.004	.601	.427	.847
Sex of household head(1)	.113	.056	4.075	1	.044	1.120	1.003	1.250
Salaries/wages/ commission			29.829	8	.000			
Income from a business	-.204	.113	3.229	1	.072	.816	.653	1.019
Remittances	-.042	.097	.190	1	.663	.959	.792	1.160
Pensions	-.147	.248	.351	1	.554	.863	.531	1.404
Grants (including old age grants)	-.379	.075	25.398	1	.000	.685	.591	.793
Sales of farming products and services	-.147	.657	.050	1	.823	.864	.238	3.132
Other income sources e.g. rental income, interest	-.403	.309	1.701	1	.192	.669	.365	1.224
No income	-.271	.285	.902	1	.342	.763	.436	1.334
Unspecified	-.234	.153	2.342	1	.126	.791	.586	1.068
Formal-urban			728.505	2	.000			
Traditional	-2.077	.085	592.691	1	.000	.125	.106	.148
Farms	-2.468	.108	520.654	1	.000	.085	.069	.105
12-26			51.832	4	.000			
27-41	-.820	.142	33.378	1	.000	.441	.334	.582
42-56	-.701	.113	38.310	1	.000	.496	.397	.619
57-71	-.544	.104	27.289	1	.000	.581	.474	.712
72+	-.240	.097	6.130	1	.013	.787	.651	.951

Primary School			90.803	5	.000			
College	.439	.074	35.141	1	.000	1.551	1.341	1.793
Cert/degree	.658	.133	24.368	1	.000	1.932	1.487	2.508
Post-graduate degree	1.845	.464	15.850	1	.000	6.331	2.552	15.704
No schooling	-.231	.087	7.011	1	.008	.793	.669	.942
DNK and unspecified	-.290	.216	1.801	1	.180	.749	.490	1.143
No monthly income			7.654	4	.105			
Low income	-.245	.656	.139	1	.709	.783	.216	2.833
Moderate income	-.336	.655	.262	1	.608	.715	.198	2.581
High income	-.469	.639	.538	1	.463	.626	.179	2.189
Unsure	-.617	.629	.961	1	.327	.540	.157	1.853
Constant	6.355	.715	78.971	1	.000	575.353		

a. Variable(s) entered on step 1: South African provinces, Population group of household head, Sex of household head, Income sources, Geography type, HH Age Group, H level of education, Monthly income of HH.

Appendix 5

Classification of national province

Code	**1**	**2**	**3**
Province	Western Cape	Eastern Cape	Northern Cape
Code	**4**	**5**	**6**
Province	Free State	KwaZulu-Natal	North West
Code	**7**	**8**	**9**
Province	Gauteng	Mpumalanga	Limpopo

Appendix 6

Classification of household head age

Code	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Year	00–04	05–09	10–14	15–19	20–24	25–29	30–34	35–39
Code	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Year	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75+

Appendix 7

Classification of household head gender

Code	**1**	**2**
Gender	Male	Female

Appendix 8

Classification of household head's level of education

00	Grade R/0
01	Grade 1/Sub A/Class 1
02	Grade 2/Sub B/Class 2
03	Grade 3/Standard 1/ABET/AET 1
04	Grade 4/Standard 2
05	Grade 5/Standard 3/ABET/AET 2
06	Grade 6/Standard 4
07	Grade 7/Standard 5/ABET/AET 3
08	Grade 8/Standard 6/Form 1
09	Grade 9/Standard 7/Form 2/ABET/AET 4/NCV Level 1/Occupational Certificate
10	Grade 10/Standard 8/Form 3/NCV Level 2/Occupational Certificate;
11	Grade 11/Standard 9/Form 4/NCV Level 3/Occupational Certificate;
12	Grade 12/Standard 10/Form 5/National Senior Certificate/Matric/ NCV Level 4/Occupational Certificate;
13	NTC l/N1
14	NTC ll/N2
15	NTC lll/N3
16	N4/NTC 4/Occupational Certificate
17	N5/NTC 5/Occupational Certificate
18	N6/NTC 6/Occupational Certificate
19	Certificate with less than Grade 12/Standard 10
20	Diploma with less than Grade 12/Standard 10
21	Higher/National/Advance certificate with Grade 12/Std 10/Occupational Certificate
22	Diploma with Grade 12/Standard 10/Occupational Certificate
23	Higher Diploma/Occupational
24	Post Higher Diploma (Master's Diploma and Master's Degree)
25	Bachelor's Degree/Occupational Certificate
26	Honours Degree/Postgraduate Diploma/Occupational Certificate
27	Doctoral Degrees (Doctoral Diploma and PhD)
28	Other
29	Do not know
98	No schooling
99	Unspecified

Appendix 9

Classification of household head monthly income

Code	a	b	c	d	e	
Monthly salary	None	1-200	201-500	501-1000	1001-1500	
Code	**f**	**g**	**h**	**i**	**j**	
Monthly salary	1501-2500	2501-3500	3501-4500	4501-6000	6001-8000	
Code	**k**	**l**	**m**	**n**	**o**	**p**
Monthly salary	8001-11000	11001-16000	16001-30000	30001+	Don't know	Refusal

Appendix 10

Classification of household head income source

Code	Income Sources
1	Salaries/wages/commission
2	Income from a business
3	Remittances
4	Pensions
5	Grants
6	Sales of farm products and services
7	other income sources, e.g. rental income, interest
88	Not applicable
99	Unspecified

Appendix 11

Classification of distance travelled to water source

Code	1	2	3	4	5	6	7
Distance to a water source (m)	<200m	201m to 500m	501m to 1km	>1km	Do not know	NA	Unspecified

< = less than; > = more than; m = meters; km = kilometre; NA = not applicable

Appendix 12

Household water of quality perceptions

code	Safe to drink	code	Taste	code	Smell	Code	Clear
1	Yes	1	Yes	1	Yes	1	Yes
2	No	2	No	2	No	2	No
9	Unspecified	9	Unspecified	9	Unspecified	9	Unspecified

Appendix 13

Classification of household source of water

Code	Main source of water
01	Piped (tap) water in dwellings
02	Piped (tap) water on site or in yard
03	Borehole on site
04	Rain-water tank on site
05	Neighbour's tap
06	Public/communal tap
07	Water-carrier/tanker
08	Water vendor
09	Borehole outside yard
10	Flowing water/stream/river
11	Stagnant water/dam/pool
12	Well
13	Spring
14	Other.