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DEMOGRAPHIC ASPECTS OF MIGRANTS' ACCESS TO DRINKABLE WATER IN SOUTH AFRICA: INSIGHT FROM THE 2011 CENSUS

By

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Acronyms

ANC- African National Congress

COGTA- Corporate Governance and Traditional Affairs

CSIR- Council for Scientific and Industrial Research

DWA- Department of Water Affairs

DWAF- Department of Water Affairs and Forestry

DWS- Department of Water and Sanitation

FBW- Free Basic Water

FAO- Food and Agriculture Organization

FBWP-Free Basic Water Policy

GHS- General Household Survey

MDG-Millennium Development Goals

NWA-National Water Act

RDP- Reconstruction and Development Programme

SA-South Africa

SDG- Sustainable Development Goals

SPSS-Statistical Package for the Social Sciences

SSA- Sub-Saharan Africa

StatsSA-Statistics South Africa

UN-United Nations

UNDP- United Nations Development Programme

UNHRC-United Nations Human Rights Council

WSA-Water Service Act

WSS-Water Supply and Sanitation

DECLARATION

I, Vuyolethu Duba hereby declare that 'Demographic aspects of migrants' access to drinkable water in South Africa: Insight from the 2011 Census' is my own work, that it has not been submitted for any degree or examination in any academic institution, and that all the sources I have used or quoted have been indicated and acknowledged by complete reference.

Vuyolethu Duba November 2020

Signed…… Date……...

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Most importantly, I would like to give all thanks and glory to my redeemer, Lord Jesus Christ, for giving me an immense strength and guidance throughout this academic endeavour. *"But he said to me, "My grace is sufficient for you, for my power is made perfect in the weakness." Therefore, I will boast all the more gladly about my weakness, so that Christ's power may rest on me"* (2 Corinthians 12:9). Father I thank you for your love, in my weakness you became my strength you never left nor forsaken me, I thank you for your mercy upon my life.

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DEDICATION

I dedicate this dissertation to both my late mother (Nosiseko) and sister (Zizipho). I know you guys are rejoicing with me, till we meet again.

I also dedicate this thesis to my father, Enkosi Mbathane, friends and family, and to everyone who played a role to reach the end results. I thank you all.

ABSTRACT

The issue of migrants' access to drinkable water is a developmental issue. From a fundamental research view point, this study aims to explore the circumstances in which migrants access water across metropolitan and non-metropolitan areas of South Africa. The study examines the inequalities that may arise in the context of piped water access, different water sources, other alternative water, reliability of water, and closely related issues focusing specifically on internal migrants in general. The study focuses on demographic characteristics such as age, gender, education, employment status, level of income, duration of residence, province of residence and ethnic groups. Bringing together the demographic variables and water related variables, the study captures the determinants of water access by comparing metropolitan and non-metropolitan areas. Using the 2011 Census secondary data requested from Statistics South Africa, cross tabulation and bivariate statistical analysis by means of SPSS software was performed. Multivariate analysis, by means of logistic regression, was used to determine the relationships and likelihood of the factors contributing to migrants' access to drinking water in South Africa.

The results obtained indicate that the inequality against migrant's access to water across areas of residence exists. Migrants in non-metropolitan areas are still struggling to access clean water for household use. The study found that women have to travel a long distance to fetch water, and they are still using water from unprotected sources such as rivers, dams, spring. The study revealed further that, employment, income, and level of education are the main contributing factors to access to water across metropolitan and non-metropolitan areas.

Key words: Migration, Piped water, water source, Metropolitan, Non-metropolitan

CHAPTER 1: INTRODUCTION

1.1 Overview

This study aims to examine the relationship between migration and access to water in South Africa (SA). Migration can be defined as a change in the usual place of residence that involves the crossing of an administrative boundary. Internal migration in developing countries has contributed to increased water stressors in meeting urban demand in destinations typically selected by migrants (Shan *et al.*,2015). As stressed by Collinson and colleagues (2007), global population growth is becoming increasingly concentrated in urban areas of the developing world. In sub-Saharan Africa (SSA), for example, the urban population was 15 percent in 1950, 32 percent in 1990, and is estimated to be 54-60 percent by 2030 (Collinson *et al.*,2007). This increased population will bring the challenge of rapidly growing water demands (Walter, Kloos and Tsegai, 2010). The inability to fulfil the needs of the growing population has led to insufficient water of low quality being supplied (Adekalu, Osunbitan and Ojo, 2002). Ramulongo and colleagues (2016) expand on this by stating that the water crisis has become a worldwide trend and is due to population growth and economic development. Water authorities and planners are struggling to satisfy the increasing water demands and, at the same time, are failing to achieve sustainable water systems (McDonald et al.,2014).

Increasing urbanization in Africa produces noticeable inequalities between the urban and rural areas which necessitate an understanding of migration patterns. In Nigeria, for instance, the rate of urbanization at 5.3 percent per year is making the urban growth in Nigeria the fastest in the world (Apata *et al.,* 2015). In Ghana, 49 percent of the urban population in 1998 were migrants and it increased to 52 percent by 2006 (Adaku, 2013). However, the unplanned urban growth makes an impediment to the local authorities' efforts to improve and distribute basic infrastructure and essential services. Unsatisfactory provision of basic amenities such as drinking water can adversely affect the living conditions of urban dwellers (Behera *et al.,* 2020).

In the context of SA, internal migration is not a recent phenomenon (Nsengiyumva, 2013). The lifting of colonial and apartheid restrictions led to internal movement, freeing up opportunities for pursuit of livelihoods away from places of usual residence. The rapid rate of migration across South Africa's nine provinces from 1994 indicates that the challenge grows as more people pursue better services, including clean household water (Dos Santos *et al.*,2017).

Internal migration in SA is predominantly urban-ward (Collinson *et al*, 2007). In 2001, some 56 percent of South Africa's population were found to live in cities. Since the 1990s Johannesburg has been the main destination for almost 40 percent of migrant workers. Other workers may begin a step-by-step migration journey by initially moving from rural areas to small towns. As noted by Collinson *et al.,* (2006), there is also evidence of migrants moving from large metropolitan areas to secondary cities.

Research has shown that Johannesburg, Cape Town, and Durban, along with Ekurhuleni and Tshwane, are considered metropolitans offering better service delivery, making them preferred areas of destinations (Rhodes and McKenzie, 2018). Despite being the heart of SA's economy, these cities are also sites of great inequality in terms of service delivery, including water. The post-1994 government inherited a legacy of inequality of access to services, infrastructure, and social capital, leaving South Africa a highly divided society (Rhodes and McKenzie, 2017). In addition, internal migration occurring in the country creates a number of challenges, including increased demand for service delivery on municipalities that are already struggling to deliver. Poor and vulnerable households, such as those residing in urban slums, are experiencing unreliable water supply with no alternative options (Price, Adams and Quilliam, 2019). According to Aleixo *et al.,* (2019), the existence of such inequalities concerning access to drinking water can be associated with specific groups within a community, particularly groups that are already marginalized. However, with the continued growth of urban population, there is a concern that the gap between availability, supply, and demand for fresh water will widen even further and excessively affect informal settlements where the majority of the population live (Aleixo *et al.*,2019).

Historically, clean piped water was associated with white privilege in SA, with the majority of black South Africans only having access to water far from their homes (Rhodes and McKenzie, 2018). In 1994 the country faced a huge water backlog; through the use of both the Reconstruction and Development Programme (RDP) and the Bill of Rights, the SA government drew up a white paper on water supply and sanitation. Since then, the government made a clear commitment to ensuring free basic water supply for all by 2013, defined as 25 L per person per day of acceptable quality water at a minimum flow of 10 L per minute, and available at least 350 days of the year, uninterrupted for less than 48 consecutive hours per supply incident (Rhodes and McKenzie, 2018).

Furthermore, in 1997, South Africa declared water a human right under the Water Services Act, consistent with the Bill of Rights. It was estimated in 2005 that approximately 6 million South Africans still lacked access to basic services including clean drinking water. According to the Agriculture Organization (2008) report, areas more susceptible to severe water scarcity are those with high population densities and with low availability of fresh water. Typical examples in SA are the Gauteng and Western Cape provinces. Estimates suggest that Gauteng will receive a net immigration of 1.02 million people between 2016 and 2021 (Mnisi, 2020). According to Stats SA (2018), Gauteng province remains the leading centre for both international (cross-border) and domestic migrants from rural areas of Limpopo, KwaZulu-Natal, and the Eastern Cape; the Western Cape is the second major in-migration centre. Between 1995 and 2018, Cape Town's population grew by 79 percent, a growth not matched by dam storage capacity despite the fact that population growth resulted in increased water demand at the residential level (Mnisi, 2020).

Failure to secure safe and reliable water can result in excessively high levels of migration away from places of residence, or it can drive people to use unclean water sources. This can place an undue burden on health services and increases the probability of death, especially amongst children under five years of age.

Much progress has been made concerning water access in South Africa. Households with general access to water infrastructure rose from 61.7 percent in 1994 to 95.5 percent in 2012. In addition, some millennium development goal (MDG) targets have been met, although it has been publicly acknowledged that much work needs to be done. Records show that 40.7 percent of households had access to piped water inside their homes in 2002, and that this rose to 41.5 percent by 2010. Moreover, the number of households using borehole as their primary sources of drinking water had risen by 1.3 percent (Rhodes and McKenzie, 2018).

Studies in the field of migration in general, and internal migration in particular, have attracted the attention of researchers and scholars. However, studies linking water accessibility and internal migration in the context of South Africa is still under-researched. There is little current work being done to examine socio-demographic, socio-economic, and migratory characteristics of migrants who access water for household consumption across metropolitan and non-metropolitan areas. Therefore, to fill this gap, there is a need for more empirical research into the topic.

1.2 Statement of the problem

South Africa has a population of approximately 58 million people. The country has been stricken by various challenges such as land invasions, housing and electricity backlogs. A further crisis looms in the form of access to drinking water. As more people migrate into cities from rural areas, the pressure experienced by these cities to meet water demands is ever increasing. Climate change is a key factor behind the growing water crisis in SA due to the infrequency of rain, which usually supplies the country's reservoirs. Despite the acknowledgement that SA has recently met its Sustainable Development Goals (SDGs), migrants have remained disadvantaged in many ways (Dos Santos *et al.*,2017). From a development perspective, migrants' access to clean drinking water remains a key issue. The country is faced with multi-dimensional challenges regarding access to scarce resources, including drinking water in general, and among migrants in particular. Firstly, there exists virtually no statistical profile as regards access to water by migrants in South Africa. Secondly, there is a lack of official statistics across SA's nine provinces regarding the direction of migration. Thirdly, the social demographic characteristics regarding water accessibility among migrants in South Africa have not been documented. Fourthly, there is scarce information available concerning the sources from which those migrants who have access to water obtained it or where alternatives were to be found in the case of water outages. Fifthly, little is known about how reliable water access is among migrants across the municipalities of South Africa. Lastly, the literature has not aided in determining the profile of migrants who eventually accessed water for consumption. Hence, this research will explore these demographic dimensions regarding migrants' access to drinking water as well as provide a detailed comparison with which to measure whether there are differences and similarities across metropolitan and non-metropolitan areas in South Africa.

1.3 Research questions

The following research questions were investigated through this study:

- What is the magnitude and direction of internal migration across South Africa's nine provinces?
- Is there a relationship between migrant demographic characteristics and access to piped water, water sources, and water supply reliability?

- What factors contribute to access to: piped water, water sources, alternative water sources, and its reliability across metropolitan and non-metropolitan areas?
- Are there any differences or similarities in migrant access to piped water between metropolitan and non-metropolitan municipalities?

1.4 Hypotheses to be tested

The following hypotheses were be tested:

- In South Africa, people are more likely to migrate to more urbanised provinces such as Gauteng and the Western Cape.
- There is a relationship between migrant demographic characteristics and access to piped water, water sources, and reliability of water supply across areas of residence
- Employment, income, population group, and level of education of migrant are the main factors contribute to water access across areas of residence.
- Socio-economic characteristics, such as employment status and income, determine access to water and reliability of water supply in areas of residence.

1.5 Aims and objectives of the study

1.5.1. General objective

To examine the demographic aspects of access to water by migrants in SA'

1.5.2. Specific objectives

1. To examine the relationship between migrant demographics and access to piped water
2. To measure the relationship between migrant demographics and alternative water sources
3. To measure the relationship between migrant demographics and water supply reliability

1.6 Significance of the study

The study provides a niche on migrant access to water. It contributes towards inequalities and differentials in water access. Migration is a key issue in SA and therefore this study contributes to the existing body of knowledge by linking the issues of migration and access to water and I agree that the study serve as a guide for formulating new policies on such into the future.

1.7 Delimitation of the study

It is important to highlight that this study used the 2011 Census dataset instead of the 2016 Community Survey because the latter does not cover all the variables required for the completion of this study, including the socio-economic variable that covers employment and income. Furthermore, it could not use the recent General Household Survey (GHS) dataset because it does not include information on migration. These variables play a significant role in shaping the scope of this research.

This study excludes other types of mobility which are also referred to as migration such as the movement of people with no known place of residence. For the purposes of this study, any highly localised movement of migrants, for example from one apartment to another in the same building or from one house to another in the same neighbourhood or town, is simply considered "mobility,".

This research on migration and access to water is limited to the two areas of residence: metropolitan and non-metropolitan municipalities. The study does not distinguish between, or form any comparison between, males and females, or migrants and non-migrants. However, it does compare areas of residence in line with migrant characteristics and access to water. Due to there being a lack of current literature on the topic, the main focus of this study is to measure the relationship between migration and accessibility to water for household consumption. This is the first study that addresses these issues in the context of South Africa.

The focus of this study is on metropolitan and non-metropolitan municipality areas. The focus is on internal migration, although it could also include migrants born or previously living outside South Africa prior to the 2011 Census. The study makes use of the 2011 Census secondary data requested from Statistic South Africa and captures a true reflection of migration and water-related issues in South Africa.

1.8 Definition of key terms

Migration- A movement from one definitive area to another during a given interval involving a change of residence (United Nations, 1970).

Metropolitan area- This is an area surrounding a city. Most inhabitants of metropolitan areas have non-agricultural jobs. These areas are very developed with a density of human structures

such as houses, commercial buildings, roads, bridges, and railways (National Geographic, no date).

Non-metropolitan areas- Non-metropolitan areas, often called "the country," have a low population density and large tracts of undeveloped land. Typically, the difference between a non-metropolitan and a metropolitan area is clear, but in developed countries with large populations, such as Japan, the difference is becoming less obvious (National Geographic, no date).

Drinkable water- Also referred to as 'improved drinking water,' drinkable water includes sources that, by nature of their construction or through active intervention, are protected from outside contamination, particularly faecal matter. It comprises piped water on premises, such as piped household water connections located inside the user's dwelling, plot or yard. Other improved drinking water sources include public taps or standpipes, tube wells or boreholes, protected dug wells, protected springs, and rainwater collection (Tortajada and Biswas, 2018).

Piped-wáter: In this study, piped-water is defined as tap water from the distribution lines of a piped-water supply station.

South Africa- South Africa is divided into nine provinces: Eastern Cape, Free State, Gauteng, Kwazulu-Natal, Limpopo, Mpumalanga, Northern Cape, North West, and the Western Cape. Each of these provinces has its own legislature, premier, and executive council (South Africa Government Information, 2009). The country has a population of approximately 52 million, with more than a third of the population (34 percent) aged less than fifteen years, implying that South Africa has a predominantly young population.

1.9 Thesis outline

Chapter one of this thesis provides an introduction to the research beginning with a background to the study and a statement of the problem underlying migrant access to water. It further outlines research questions, hypotheses, objectives, significance of the study, and working definitions. Chapter Two presents a body of literature that discusses the theoretical review and the empirical review underlying the study. Chapter Three outlines the research design, sampling and data collection, the method used in analysis, and the delimitation and description of variables. Chapter Four presents the data analysis and results, while Chapter Five critically discusses the findings. Chapter Six presents the conclusion and suggests some recommendations for policy makers.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter reviews the theoretical framework and existing literature regarding internal migration, integrating it with access to drinking water. This will be subdivided into two sections: theoretical and empirical literature. The section on theoretical literature will give a review of the theories related to migration and access to basic services, drinking water in particular. The empirical literature section will offer discussions and debates on the existing body of research regarding migration, and will link them with migrant access to drinkable water in consideration of residential areas, in both metropolitan and non-metropolitan areas.

2.2 Migration theory

Among the existing theories on migration, such as the neoclassical economics of migration, network theory, and human capital theory, there are none that focuses on migration and access to drinking water in the South African context. Previous research has focused extensively on the push-pull factors such as the quality of basic resources, housing, employment, and better social life in general, but not specifically on how migrants access drinking water in areas of destination. White and Lindostrom (2006) note that the literature on migration is broad and interdisciplinary and that, as a demographic process, it is affected by economic, cultural, social, and psychological aspects. This chapter provides a review of migration literature that is of most relevance to this research. Following are the theories that attempt to link migration and water access.

2.2.1 Push-pull theory

This theory postulates that certain factors push or pull migrants from their areas of origin to their areas of destination (Moses and Yu, 2009). Push factors, however, refer to factors that influence an individual or a group of people to leave an area, including socio-economic, socio-demographic, and political factors. These, among others, may include factors such as unemployment, low social status, political instability and repression. Conversely, pull factors refer to those forces that drive a migrant towards a specific area, such as good environmental and living conditions, better income and employment, political stability and freedom, etcetera (Eigelaar-Meets, 2018). This model assumes that migration occurs due to economic imbalances between geographical regions. Generally, migration is a globally recognised phenomenon

believed to be triggered predominantly by economic factors but also by social, political, cultural, environmental, and health factors (Thet, 2014). Migration commonly takes place because of the push factors or loss of opportunities in the socio-economic context, and because of pull factors that occur in more industrialised areas (Thet, 2014). The common push factors include low productivity, unemployment, underdevelopment, poor-economic conditions, absence of opportunities for development, exhaustion of natural resources, and natural calamities (Thet, 2014). De Haas (2009) states that the decision to migrate is primarily influenced by factors associated specifically with the areas of origin and areas of destination. These are so-called prevailing obstacles such as distance, physical barriers, nature of migration laws, and personal factors (De Haas, 2009).

Examining the decisions for migration at an individual, or a micro, level, one could argue that the various factors influencing this movement of people from one place to another are unique to each individual. Regardless, in each area exist many factors that keep people static, create an attraction for movement towards an area, or repel people from an area (Lindstrom and Ramirez, 2010; Majikijela, 2015).

De Haas (2009) perceives migration as a social process, claiming that people do not necessarily migrate because they expect to be able to make a more sustainable living elsewhere; rather, migrants can be seen to migrate away from areas with relatively low population densities and little environmental degradation to environmentally degraded areas with higher population densities.

2.2.2 Network theory

This theory is based on the sets of social connections that tie current migrants, former migrants, and non-migrants to areas of origin or destination through the bonds of relationship, friendship, and shared community origin (Kiros and White, 2004). These connections may influence more people to migrate, as one may not fear starting a new life on one's own knowing there are friends or family already in the area. There has been a particular focus on the role of kinship and friendship networks in encouraging and facilitating migratory movement (Ryan, 2011). It may be the case in South Africa that these networks encourage migration between metropolitan and non-metropolitan residents. In the context of this study, it may be the case that neighbours, friends, or relatives exchange information regarding their experiences with access to water services in their places of destination. These relationships and contacts may influence decisions to migrate, provide money to finance moves and, after migration, provide accommodation,

jobs, information, and emotional support (Ryan, 2011). Furthermore, De Haas (2009) notes that once a substantial number of migrants have settled in an area of destination, the migration process becomes self-perpetuating as it creates the social structures to sustain the process. Contrarily, not all of these networks are as useful or influential to social mobility or migration as suggested in the above discussion; this is because the network quickly becomes redundant in terms of access to new information (Giulietti *et al.*,2018).

2.2.3 Migration and selectivity theory

It is apparent from the literature that migrants are not homogeneous but differ based on demographic and socio-economic characteristics such as age, gender, marital status, education, and employment status (Majikijela, 2018; Eigelaar-Meets, 2018). Kok and Aliber (2005) argue that not everyone in a population has the same opportunities for migration or reasons to migrate during any given time. Some demographic features, such as age, have been identified as more consistent selectivity factors, while others, such as gender, are not consistent in all parts of the world (Eigelaar-Meets, 2018). This suggests that people with certain characteristics are more migration-prone than others. Socio-economic selectivity factors, such as education level, have at times been acknowledged, while personality-related factors, for example, risk-taking behaviour, have been suggested as potentially vital in migration selectivity (Kok and Aliber, 2005). The general thinking in migration phenomenon, whether internal or international, is that younger people are more inclined to migrate than older people (Bouare, 2001; Lindostrom and Ramirez, 2010; Eigelaar-Meets, 2018). For instance, migrants are predominantly found to be young unmarried adults and are described as determined and adventurous risk-takers (Lindostrom and Ramirez, 2010).

Education and skills characteristics are identified as other factors determining the movement of people. Fratesi and Percoco (2010) argue that migrants, both internal and international, are, on average, more skilled and educated than non-migrants in all regions, confirming that skilled people are more mobile. Furthermore, Kok and Aliber (2005), in their study regarding the causes and economic impact of human migration from the Eastern Cape, Northern Cape, and Limpopo to the major cities in South Africa, discovered that individuals migrating from these provinces were considerably more educated and skilled than those who remained behind. The inclination of these better educated individuals to migrate may be ascribed to the higher probability of securing employment in areas of destination (Eigelaar-Meets, 2018). According to Fratesi and Percoco (2010), educated migrants are more likely to prefer living where other

educated workers do. The same goes for high skill workers, potentially because of social interaction preferences relating to education level. Furthermore, internal migration flows are selective and biased towards the most qualified persons (Fratesi and Percoco, 2010).

2.3 Empirical literature

This section discusses the available empirical literature on the issues surrounding migration and water services in SA.

2.3.1 Study areas

The study area is the Republic of South Africa (RSA), situated in the southernmost country on the African continent. South Africa constitutes over 59 million people, and it is the world's 24th most populous nation and covers an area of 1,221,037 square kilometres. South Africa has three capital cities, such as executive (Pretoria), judicial (Bloemfontein) and legislative (Cape Town). The largest city in South Africa is Johannesburg. About 80% of South Africans are of Black African ancestry, divided among a variety of ethnic groups speaking different African languages (South African government information, 2009).

2.3.1.1 South African provinces

South Africa consists of nine provinces: Western Cape, Eastern Cape, Northern Cape, North West, Free State, KwaZulu Natal, Gauteng, Limpopo and Mpumalanga. Each province has its own charm and attractions.

Figure 2.1: Map of South African provinces

***Source**: http://www.southafrica.info/about/government/govlocal.htm#.UmFLHVOmbcc*

2.3.1.2 Metropolitan of South Africa

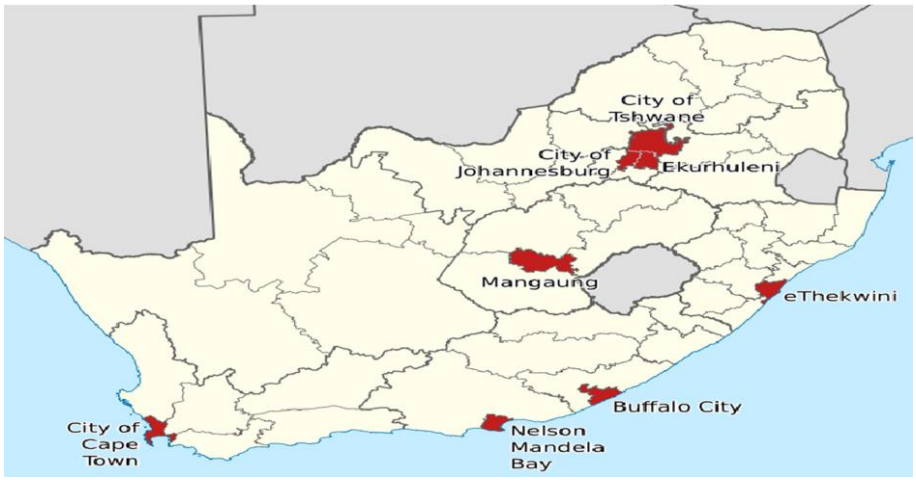
According to Koopman (2000), a metropolitan area is assumed to be a distinctive form of human settlement that contains a great number of people living in and around one or more centres of high densities. These centres have a high degree of economic and social integration and are more quickly settled and intensively used for urban activities. South Africa has eight metropolitan municipalities namely: the City of Cape Town in the Western Cape; the City of Johannesburg and Ekurhuleni Metropolitan Municipality in Gauteng; Mangaung Municipality (Bloemfontein) in Free State; City of Tshwane (Pretoria) in Gauteng; Nelson Mandela Metropolitan Municipality (Port Elizabeth) in the Eastern Cape; Buffalo City (East London), also in Eastern Cape; and City of eThekwini (Durban)in KwaZulu-Natal (Karuri-Sebina *et al.*, 2016).

Table 2.1: South African Metropolitan Municipalities

Metropolitan Municipality	Population in 2001	Population in 2011
City of Cape Town	2 892 243	3 740 026
Johannesburg	3 226 055	4 434 827
Mangaung	6 46 440	747 431
City of Tshwane	2 142 322	2 921 488
Nelson Mandela Bay	1 005 779	1 152 116
Buffalo City	704 855	755 200
Ekurhuleni	2 481 762	3 178 470
EThekwini	3 090 122	3 442 361

Source: *South African cities report, 2013*

Figure 2.2: Map of metropolitans of South African



***Source**: http://www.southafrica.info/about/government/govlocal.htm#.UmFLHVOmbcc*

Buffalo City and Mangaung were originally local municipalities which were separated from their district municipalities and upgraded to metropolitan status in 2011. The other six municipalities were founded as metropolitan municipalities at the inception of the current system of local government in 2000 (Local government information, 2007).

2.3.1.3 Non-metropolitan municipality

Non-metropolitan municipalities consist of the areas outside metropolitan municipalities; this includes district councils and local councils (Koopman, 2000). Hence, each district (or category C) municipality is divided into a number of local (category B) municipalities. District municipalities have responsibility for broader matters such as integrated planning, infrastructure development, bulk supply of water and electricity, and public transport; while local municipalities have responsibility for all municipal functions not assigned to the district, and in particular local service delivery. As of 2016 there are 44 district municipalities divided into 205 local municipalities (South African government information, 2009).

2.3.2 Definition of migration

Migration is an ambiguous concept and controversial to define, since it can cover multiple events (Kok, 1997; Skeldon, 2017). Kok and Skeldon raise the issue that there are certain key areas to be covered for a complete definition of migration. According to Kok (1997), these include distance (spatiality) and time (duration of residence). For a person to be referred to as a "migrant," two things should be considered: the duration of stay at a given destination; and

the distance travelled to the point of destination (Skeldom, 2017). These considerations give insight into the type of migration a person is involved in, that is internal and international migration - which is movement occurring within the same country - and movement occurring outside of that country, respectively. This study focuses on internal migration in South Africa.

Migration, in general, can be defined as a change in the usual residence and which involves the crossing of an administrative boundary. The migration process can be a long or short one, depending on the duration spent at the destination (Sithole, 2015). In the context of this study, internal migration refers to movement occurring within a country, whether within or between provinces, rural to urban, urban to rural, urban to urban or rural to rural (Yeboah, 2015, World Economic Forum, 2017).

2.3.3 Historical context of internal migration in South Africa

Following the trends of migration and social structure in South Africa prior to 1994, there were clear boundaries and constraints in the movement of certain population groups as well as defined social stratifications within the country, including inequalities in service distribution. Under the apartheid regime, processes regarding migration and urban residency rights for black populations, and black women specifically, were restricted by authorised control, for example, the influx control and Coloured Labour Preference Policy (Bouare, 2001; Cox *et al.*,2004; Hosegood *et al.*, 2005; Kok *et al.*,2005; Phago, 2009; Eigelaar-Meets, 2018). As suggested by Cox *et al.*, (2004), one of the primary aims of influx control policy was to perpetuate labour migration. Meanwhile, the Coloured Labour Preference Policy was designed to favour coloured over black labourers in the Western Cape. Under the influx control system, there was a small group of labour migrants who succeeded in taking their families with them to urban areas (Kok *et al.*,2005). The mining industry in cities, particularly in Gauteng, attracted many labour migrants from rural areas and neighbouring countries (Hosegood *et al.*,2005; Collinson *et al.*,2006). Throughout this era, restriction and deprivation of human rights were not focused purely on population movement and migration, but also on other social involvements such as provision of basic services and infrastructure, including the supply of, and access to, safe drinking water (Smit, 1998). According to Boure (2001), under the policy of "separate development," the majority of South Africans, particularly the black population, were left to fend for themselves with regard to water services. This resulted in an estimated 16-19 million people without a formal water supply and 21 million people being without sanitation during that era (Abrams *et al.*,1998).

The culmination of the apartheid system of racial segregation in South Africa during the late 1980s and early 1990s ushered in freedom of movement with no prohibition (Phago, 2009; Reed *et al.*,2012; Posel, 2004; Phala, 2017; Eigelaar-Meets, 2018). It is believed that the abolishment of apartheid contributed to social changes, which included a rapid increase in migration with people moving to cities and overwhelming the distribution of services.

According to Phago (2009), the end of apartheid released the bulk of the rural population who were otherwise restricted to the homelands (bantustans) and propelled them into cities to search for work and better services. South Africa has since then experienced high population densities in metropolitan areas (Phago, 2009). However, migrants are normally perceived as a threat contending for access to already limited resources, including access to water services in the areas of destination (Bakewell, 2009).

2.3.4 Access to safe drinking water in developing countries

In many developing countries, piped water is most likely to be accessed in community water systems outside the dwellings and often consists of a single public standpipe that requires water collection and transportation from remarkable distances, followed by storage inside the dwelling for a period of twenty-four hours or more (Trevett, Carter, and Tyrrel, 2004). However, even though piped water from community stands can supply safe water quality, there is the considerable possibility of deterioration and contamination occurring during collection, transportation and any other handling process involved between supply and consumption (Trevett, Carter, and Tyrrel, 2004; Wright, Gundry, and Conroy, 2004).

Katuwal and Bohara (2011) state that the majority of households in the urban area of a developing country report that there is either no water at all, or the discharge of water is low. Seventeen percent of people connected to the distribution system claim that water from their tap is contaminated (Katuwal and Bohara, 2011).

Safe drinking water is of paramount importance and is regarded as a human right (Kolanisi, 2005; Jansen, 2012; Pandit and Kumar, 2015; Moloto and Khalo, 2017). Drinking water should be appropriately free from any kind of contaminant, whether physical, chemical, or biological, and be able to be safely used for domestic purposes such as consumption, bathing, and cooking, etcetera. (Adekalu, Osunbitan and Ojo, 2002; Pandit and Kumar, 2015). In other words, drinking water quality must adhere to the sustainability guidelines of a water regulatory authority (Pandit and Kumar, 2015). This includes sources such as piped water on-premises,

plot or yard; boreholes; protected; protected springs, and rainwater collection (Tortajada and Biswas, 2018).

Katuwal and Bohara (2011) argue that one of the main problems in cities of developing countries is the provision of sufficient good quality drinking water. According to Mahama *et al.,* (2014), access to improved water for consumption and other domestic use is a major developmental issue in many developing countries. The authors further claim that approximately 1.1 billion people across the globe do not have access to potable water. Sorenson *et al.,* (2011) expand on this by stating that improved water sources are not available to a high percentage of the population in developing countries.

According to Abubaker (2019), "improved" water refers to clean water sourced from a tap installed inside the dwelling or yard, a public stand pipe, a tube-well, a protected spring/dug well, and rainfall. "Unimproved" water contributes to health issues that may consequently result in illness or death through waterborne diseases. According to Armah *et al.,* (2018), it is estimated that globally, 10,000 people die daily because of water and sanitation-related diseases. Therefore, access to improved water and sanitation reduces water-related diseases (Armah *et al.,*2018). Wright *et al.,* (2004) support this by stating that the installation of improved water sources such as standpipes, boreholes, or wells for the provision of good quality water is one of the best strategies for combating water-borne diseases.

2.3.5 Water access in post-apartheid of South Africa

In South Africa, the disparity in public resources, including access to drinking water, can be traced back to the apartheid era through spatial and racial segregation (Smith and Hanson, 2003; Cothren, 2013; Rodina and Harris, 2016). In 1994 only 27% of black households received piped water inside their dwellings, compared to 99% of white South Africans (Bond, 1999). The promise to resolve this disparity became the election theme of the African National Congress (ANC). The primary objective of the SA government during the post-apartheid era has been to redress the impacts of apartheid through a more impartial dispersal of public services. This goal has been accompanied by the desire to achieve procedural equity in which all racial groups participate and contribute to decision-making (Smith and Hanson, 2003). The motive behind this goal was to give equal rights to previously disadvantaged groups concerning accessibility in basic services. These goals of distributional and procedural equity have been important to the democratisation of service delivery, including access to water, from the time of the first free local government elections in 1994. Smith and Hanson (2003) report that

distributive equity refers to "who gets what and where" in service delivery, while procedural equity concerns the process of distribution (Smith and Hanson, 2003). As promised by the government (1994) and new constitution (1996), equitable access to basic services and related infrastructure, including water access, sanitation, electricity, and roads, has been paramount to this vision (Rodina and Harris, 2016, cited in Tissington, 2010).

However, since the end of apartheid in 1994, the government and local authorities have struggled to redress and fully abolish historical inequalities in service delivery while undergoing a prolonged process of government restructuring to extend services more effectively to historically disadvantaged communities (Smith and Hanson, 2003).

Despite national policy and programmatic efforts to provide basic water services, many villages in rural areas of the country remain characterised by a disjuncture between water required for livelihood and actual access to the available water supply (Cothren, 2013). Moreover, Smith and Hanson (2003) note that geographers have called attention to the impact of both residential segregation in shaping inequalities to access of services, and the distance between service users and facilities, such as water and health clinics, in shaping differential service utilisation (Smith and Hanson, 2003).

2.3.6 Overview of current water shortage in South Africa

Generally, South Africa is experiencing water shortage (Muller *et al.*,2009; Tabane, 2017). The shortage of water resources in SA is a growing concern, as the country is located in a semi-arid region. The country's annual rainfall is below the world average, and it experiences increased evaporation rates (Perret, 2002; Department of Water Affairs and Forestry, 2004). In 2015, South Africa was listed the twenty-ninth driest of 193 countries, with an estimated 1110 cubic metres of water per person (Muller *et al.*,2009). South Africa is also known for extended dry and wet conditions that result in great temporal and spatial variability in water availability (Tabane, 2017). Rainfall varies dramatically by season, and limited available water is distributed unevenly across the country (Muller *et al.*,2009).

Consequently, the sufficient provision of water in South Africa's population is one of the most substantial challenges facing the country, and this is experienced predominantly in the rapidly growing cities (Armitage *et al.*,2015). In 2016, Statistics South Africa (Stats SA) found that just 44.4% of people had access to water inside their dwelling (Water and Sanitation, 2018). Even though the current South African government has attempted to amend the imbalances of the past, the long-term effects of the inequalities continue to this day. According to Farrar

(2014), enforced poverty of black, coloured, and Indian communities during the apartheid period affects these communities in the present time, with close to 50% of the country being classified as poor in 2010. One of the most fundamental aspects of this great inequality is the differences in the levels of services provided to different communities, though the government is committed to rectifying this through "pro-poor" policies such as the Free Basic Water Policy (Farrar, 2014). Despite the fact that access to water and sanitation has increased in post-apartheid South Africa, the number of individuals deprived of access to consistent water supply and acceptable sanitation remains excessively high (Water and Sanitation, 2018).

2.3.7 Inequality of water supply between urban and rural areas

According to Adams (2018), the majority of the poor in sub-Saharan Africa live in informal settlements in urban areas and have limited access to potable water. However, the literature suggests that access to improved water sources for consumption is significantly higher in urban areas compared to rural areas (Barde, 2017). Improved water sources in urban areas include the management and treatment of water – a source that is rare to find in rural areas. Tissington *et al.*, (2008) state that urban water infrastructure typically includes water collection and storage facilities at source sites; water transport via waterways from source sites to water treatment facilities; water treatment, storage and distribution systems; wastewater collection systems and treatment; and urban drainage works. Water requires treatment before use. Once treated, urban water can be stored and distributed within the urban area, usually through a network of storage tanks and pipes. Pipe flows in urban distribution systems should be under pressure to prevent contamination from groundwater and to meet various user and fire protection requirements (Tissington *et al.*,2008).

Supplying water to rural areas in South Africa is accomplished primarily through small community water systems. These systems deliver a defined level of service referred to as a "basic" water supply service (Moloto and Khalo, 2017). According to these authors, the standards defining basic water service require that communal taps or standpipes using the abstraction technology have a maximum distance of 200 metres from each household, with a minimum quantity of 25 litres per capita per day and offering a minimum flow rate of 10 l/min with a minimum reliability of 98 percent (Moloto and Khalo, 2017).

2.3.8 Access to water sources

Access to improved water sources has been considerably increased in urban areas of the developing world over the last twenty years, but in rural areas, this development is still lagging. Only 28% of the 1.6 billion people residing in rural areas who gained access to piped water inside dwellings during 1990-2012 (Barde, 2017). In the year 2000, only 85% of the world's urban population had sufficient access to water, in contrast to only 47% of the rural population (Tabane, 2017). In the context of African countries, 75% of the population is rural and thus face a growing challenge of water shortage (Pelser, 2001).

Access to sufficient clean water from safe water sources is a basic requirement for every individual (Armah *et al.*,2018). Consumption of unsafe water from contaminated water sources can lead to the risk of infectious diseases that can result in high morbidity and mortality. This is one of the most serious challenges for developing countries, and South Africa in particular (Katuwal and Bohara, 2011; Misati, 2016). Katuwal and Bohara (2011) argue that rapid urbanisation and population growth have made developing countries unable to meet the increased demand for improved water sources, and the situation is exacerbated by an increasing population.

2.3.9 Alternative water sources

Alternative water sources are used in times of unreliability or failure of supply from usual sources. Dolnicar and Hurlimann (2009) state that growth in population through migration and climate variability have significant implications on water availability around the world. Therefore, these pressures on water resources suggest that there is a need for diversification, which may include the use of alternative water sources (Fielding *et al.*,2015). According to Majuru *et al.,* (2016) these sources include communal taps or boreholes, springs, and surface water. In other studies, alternative water sources most likely refer to recycled and desalinated water (Dolnicar and Hurlimann, 2009; Fielding *et al.*,2015). Alternative water is also part of the City's water resilience drive, as the City recognizes that going forward water scarcity is the 'new normal'. Currently, municipalities are promoting the use of alternative water sources, which can help minimize the quantity of water drawn from the dams (Department of Water and Sanitation, 2017). In South Africa, all alternative water systems are subject to approval from the City, and the use of groundwater, surface water and treatment of own wastewater is also subject to authorisation and licencing from the national Department of Water and Sanitation (DWS) (Department of Water and Sanitation, 2017).

2.3.10 Reliability of water supply in developing countries

Reliability of water supply service is commonly defined as the amount of time that the service functions to its prescribed level (Majuru *et al.*,2016). In most poor areas of developing countries, water supply is unreliable, the pressure is too low to pump water to the tap, and the amount of water made available to the public is not directly potable (Katuwal and Bohara, 2011). Majuru *et al.,* (2016) also argue that even though the MDG targets for drinking water are met, water supplies are not consistent in many developing countries. Majuru *et.al.* (2016) further note that the unreliability of water supplies will persist in many developing countries. South Africa is not exempt from this issue, especially in rural areas. Therefore, it is critical to consider developing effective strategies for ensuring households obtain safe and sufficient quantities of water at an affordable cost.

2.3.11 Socio-economic impact on water supply in South Africa

According to Tabane (2017), "economic water scarcity" defines water as being available but economically inaccessible. This is most commonly experienced in non-metropolitan areas due to the fact that they lack suitable water infrastructure and that municipalities lack the financial/economic or institutional ability to serve basic water and sanitation services to their population (Jansen, 2012). Economic factors can also determine whether or not infrastructural investments can occur for the purposes of ensuring access to safe drinking water. Subsequently, even though water may be available in the physical sense, the relevant infrastructure and treatment facilities may be lacking (Tabane, 2017). An investigation made by the Council for Scientific and Industrial Research (CSIR) (2006) into the state of municipal infrastructure in South Africa showed that whereas many municipalities had put in place good practices in terms of infrastructural maintenance, few had adequate plans for the provision of renewal infrastructure.

The investigation further showed that institutional and financial capacity varied significantly between municipalities. Shortage of technical staff, failure to plan and allocate funds wisely, and dependence on the national government to provide financial support were some fundamental reasons for the wide discrepancies in service delivery (CSIR, 2006). Based on a report by Corporate Governance and Traditional Affairs (COGTA) released in 2009, rural municipalities face severe infrastructural backlogs requiring considerable improvement in financial and institutional capacity. Urban municipalities are not immune from challenges.

They face growing populations - particularly an increase in informal settlements - and must therefore improve their spatial and infrastructure planning (COGTA, 2009: 45).

2.3.12 The influence of migration on water access in SA

Migration and urbanisation come with both substantial challenges and opportunities. On the negative side, the increasing concentration of the world's population in large cities constrained by a lack of financial resources and weak institutional capabilities causes risk of increasing poverty, insecurity, and environmental degradation (Turok and Borel-Saladin, 2014). On the positive side, urbanisation can transform socio-economic conditions and reduce human vulnerabilities, depending on how well the process is planned and managed (Turok and Borel-Saladin, 2014).

Changes in factors that impact on water supply and demand can result in water scarcity in many regions (Jansen, 2012). These changes include increased population growth and urbanisation (Collinson *et al.*,2007; Walter *et al.*,2010; Shan *et al.*,2015). Due to hasty changes in migration and urbanisation patterns, pressure on governments to deliver improved and expanded urban water services in both developed and developing countries is increasing (Poustie *et al.*,2015). The world population is projected to increase by 4 201 million people between 2009 and 2050 (United Nations, 2009). In sub-Saharan Africa, approximately 70 percent of the region's urban population live in urban informal settlements where they face inadequate improved water access (UN Habitat, 2013).

Attitudes towards urbanisation in South Africa are particularly complicated and ambiguous, reflecting the legacy of institutionalised racism, urban exclusion, and rural deprivation (Turok and Borel-Saladin, 2014). Restrictions in migration patterns ended when apartheid was abolished, but deep social inequalities and shortages have hampered urban integration (Turok and Borel-Saladin, 2014). Moreover, urbanisation is already inducing water demand in South Africa, and it will increase future water requirements (Jansen, 2012). Based on the United Nations (2009), South Africa's projected urban population for 2010 was 61.7 percent of the total population, as compared to the 79.6 percent anticipated for 2050. Thus, it can be expected that satisfying the basic needs of water consumption and producing goods and services that use water resources will become one of the greatest challenges in the upcoming years (Jansen, 2012).

2.4 Review of some policies on water access in South Africa

This section outlines the laws, policies, and regulations that have governed the provision of water in a democratic South Africa since 1994. The paper gives insight into the ways in which water provision is regulated, the standards to be followed, and the implications of the policy of "Free Basic Water" (FBW) adopted by the government.

2.4.1 Water departments in South Africa

Every country has its head departments that oversee the nation's water affairs. In South Africa, there is a Department of Water Affairs and a Department of Water and Sanitation with both acting as custodians of water. The Department of Water Affairs oversees the country's water and forestry resources and aims to ensure the availability and supply of water on a national level; ensure equitable and efficient provision of water services at local level; and promote sustainable forest management (Western Cape Government, 2020). The Department of Water and Sanitation endeavours to ensure that all South Africans gain access to clean water and dignified sanitation and endorses effective and efficient water resource management to ensure sustainable socio-economic development (Department of Water and Sanitation).

2.4.2 The human right to water in South Africa

According to McGraw (2011), 122 nations officially approved a human right to water and sanitation law in July 2010. This right is now embedded in international human rights law. Following this development, the United Nations Human Rights Council (UNHRC) approved a binding resolution recognising that the human right to water and sanitation is part of the right to a satisfactory standard of living (McGraw, 2011). According to the UN (2003), access to water must be universal, and discrimination against people/groups is unacceptable - including against people who cannot afford to pay. People should participate in the process of realising this right, and participation should empower them to claim their rights and hold duty-bearers accountable (UN, 2003).

In South Africa, the human right to water was approved in 1996 by the constitution in section 27(1) (b). This human right promises every citizen the right to access water and requires the government to implement reasonable legislative and other measures to progressively realise this right within its available resources (Water and Sanitation, 2018). Recognising the human right to water has implications for the approach taken in policy and service provision. The state and other duty-bearers are required to respect, protect, and make progress towards the full realisation of this right (Hazell, 2008). Based on the United Nations Development Programme

(UNDP 2006), an individual deprived access to a minimum of 20 litres of potable water daily is experiencing a violation of his or her fundamental human rights (Mahama at al., 2014).

2.4.3 Reconstruction and Development Programme (RDP) 1994

The white paper on the RDP established social objectives for the new government (Hazell, 2008). According to Perret (2002), the RDP served to assert the new direction in which post-apartheid policies would move. Despite the fact that there is no specific discussion regarding water supply, the RDP must amend unequal development and its associated lack of access to basic services for the majority of the population (Moloto and Khalo, 2017). Perret (2002) argues that accomplishing the basic needs of the population was a key reference point of the RDP, and that water was considered one of these needs.

Moloto and Khalo (2017) state that four policy documents currently reinforce the national water legislation for South Africa. These documents plan to overcome challenges in the water sector and to deliver better access to water supply, equity, and sustainability. According to Moloto and Khalo (2017), these documents are the white papers on: water supply and sanitation (1994), national water policy (1997), basic household sanitation (2001), and the strategic framework for water services (2003). In addition to these policy documents, the Water Services Act 108 of 1997 and the National Water Act 36 of 1998 provide for the establishment of institutions that are given responsibility for the management and distribution of water (Goldin, 2010). These policies strengthen SA's national water legislation by ensuring that the population receives equitable and sustainable water.

2.4.4 Water Services Act (Act 108 of 1997)

According to the Water Services Act, people have the right to basic water supply and sanitation. The Water Services Act was the first act of Parliament in the post-apartheid period that gave

effect to the right of access to basic water supply and sanitation as required by the 1996 Constitution (Dugard, 2016; Moloto and Khalo, 2017). The Act allows for the water services authority to offer measures in its water services development plan to realise these rights (Dugard, 2016; Shikwambane, 2017). The Act sets out the duties of the Water Services Authorities (WSAs), which determine the municipalities' responsibility for supplying water and sanitation services (Shikwambane, 2017). One of the duties of the WSA was to appoint a water services provider (WSP) that delivers water services to consumers or another water service institution (Dugard, 2016). This Act is wide-ranging in its scope and confirms the

national government's role as keeper of the nation's water resources. It also highlights the key role of municipalities in delivering water and sanitation services (Moloto and Khalo, 2017). The WSA further provides for national and provincial monitoring, oversight and intervention in municipal water services delivery, and calls upon all levels of government (local, provincial, and national) to work together to ensure clean, safe and affordable water for all (Moloto and Khalo, 2017).

According to Regulation 3 under section 9 and 73 of the Water Services Act, the approved standard for basic water supply is a minimum amount of 25 litres of potable water per person per day, or 6 kilolitres per household per month at a minimum flow rate of not less than 10 litres per minute. Moreover, the basic water source should be within 200 metres of a household and with such efficiency that users are not without supply for more than seven days in a year (Water Services Act, 1998).

2.4.5 The National Water Act, 1998 (Act 36 of 1998)

With the dismantlement of past regulations and the implementation of a new democratic constitution, South Africa adopted a new water policy, culminating in the National Water Act (NWA) (Perret, 2002). According to Moloto and Khalo (2017), the NWA takes a wider view of the water policy for South Africa than does the Water Services Act. The implementation of the NWA came into realisation through the acknowledgement, by the Constitution, of water as a basic human need. Therefore, according to Shikwambane (2017), the Act was passed to legalise the application of this basic human right. The National Water Act was endorsed during the transition to the post-apartheid era and is largely noticed in policy circles as one of the most comprehensive water laws in the world. The Act is enacted, adopted, and applied in a society linked with socio-economic imbalances. Hence, it provides a robust tool to redress the inequalities and imbalances of the past regime (Shikwambane, 2017). The Act aims to provide the reform of the laws relating to water resources and to provide for matters connected with it. The areas of water policy addressed by the NWA include, among others, the protection of the quality of water resources; public provision and user pricing strategies; the establishment of bodies to implement international agreements; and the safety of dams (Moloto and Khalo, 2017).

The Act is accountable for the protection, management and equitable distribution of water resource to all individuals. The NWA aims to dispense with the apartheid ideals of privileged access to water service delivery (Shikwambane, 2017).

2.5 Some identified gaps in the theoretical literature

In this study of migration and access to water, some theories have been reviewed such as Push-Pull theory, Network theory, and migration selectivity theory. However, there is no unified theory which linked migration and access to water in the context of South Africa. The major gap was noticed where, statistically, there is no information regarding the magnitude and direction of migration in the context of South Africa. There is no single theory discussed the social demographic characteristics regarding water accessibility among migrants in South Africa. The information available concerning the sources from which migrants who have access to water obtained it or where alternatives were to be found in the case of water outages is scanty. Little is known in migration theories about how reliable water access is among migrants across the municipalities of South Africa. Lastly, the theoretical literature has not aided in determining the profile of migrants who eventually accessed water for consumption. Therefore, this study is guided by the migration selectivity theory. To integrate this theory into the context of this study, one can borrow from it to establish a relationship between migrant characteristics and access to water by assessing whether migration selectivity influences migrant access to drinking water in areas of destination, such as across metropolitan and non-metropolitan areas

2.6 Conceptual framework

Migrants are not homogenous, that is, they are different according to demographic attributes such as age, gender, population group, education, employment, and income. Therefore, migrant 'access to scarce resources including water is usually associated with these demographic attributes (Nsengiyumva, 2013, Majikijela, 2015). As mentioned in the gap of this study, there is no specific theory which guide migration and access to water. However, one can still borrow from selectivity theory to explain migration and access to water. The conceptualisation is performed in line with the variables of interest and the hypotheses formulated.

2.6.1 Gender selectivity and water access

Gender is central in the migration process. Generally, migrants are predominantly males but recently females have started migrating more than they did in the past. Research has shown that gender of migrant is an important factor that influences migrant's access to water in areas of destination. Research has shown that women and men commonly have very different roles in water supply and sanitation (WSS). These differences are primarily apparent in rural areas.

In most cases, women are the main users, providers, and managers of water in rural households (Howard and Bartram, 2003). Women are also the guardians of household hygiene; men are typically more concerned with water for irrigation or livestock. Hence, women tend to benefit most when access to water quality and quantity is improving. Advancements in WSS infrastructure are likely to shorten the time spent by women and girls fetching and carrying water, thereby freeing up time for income-generating activities or school attendance respectively (Howard and Bartram, 2003). Given their long-established active role in WSS, women generally have knowledge about current water sources, their quality and reliability, any restrictions on their use, and how to improve hygiene behaviours. Yet for many years, efforts to improve WSS services tended to overlook women's central role in water and sanitation. While women were often more direct users of water, especially in the household, men traditionally had a greater role than women in public decision-making (Berkowitz, 2012). Moreover, women are the ones who access water in unimproved water sources, and they are the ones who have limitations in accessing water inside the dwellings compared to their male counterparts (Sinyolo *et al.,* 2018).

2.6.2 Education selectivity and access to water

Education is another driving force causing people to migrate. Individuals with high level of education are likely to migrate more than those who are not educated or have lower levels of education because of economic returns at destination. Therefore, level of education of migrant was found to be a crucial variable that enhances the accessibility of water across areas of destination. According to Sarner (2016), literate and educated migrant's households often have greater access to services and may also be more aware of the benefits of higher levels of water quality and sanitation services than households of a lower education. This implies that disparities also exist according to education level when accessing good quality water. Furthermore, Mbatha and Roodt (2014) state that what complicates and compounds the problem in rural areas and among the youth is lack of skills, low levels of school education, and low social capital. Mahama *et al.*, (2014) further suggest that lack of, or insufficient levels of, education serves as a strong barrier to empowerment. The lower the level of education, the fewer the opportunities afforded the individual to demand better facilities from authorities.

2.6.3 Income selectivity and access to water

Income earning plays a vital role when it comes to water access among migrants. With communities growing through migration, so the demand for water services increases. According to Rogers *et al.*, (2002), the only way to ensure that everyone has access to water is to ration it. However, a migrant's level of income is a strong determinant of availability of water in his or her household (Ngum, 2011). Dungumaro (2007) affirms that households with high income are more likely to obtain water primarily from piped taps into the dwelling compared to those depending on financial support. Consequently, most low-income housing located in informal settlements, and people in these areas suffer poor access to centres of employment and social amenities such as water (Karuri-Sebina *et al.*,2016). Therefore, it can be hypothesised that the higher the income, the more chances of accessing piped water inside the dwelling.

2.6.4 Employment selectivity and access to water

In the study of migration and access to water, employment status is considered a contributing factor to water access among migrant in the area of destination. Migrant employment can directly influence access to water, especially piped water inside the dwelling or yard. Ngum (2011) claims that households led by employed migrants would have better access to water than those who are unemployed or with lower levels of labour force participation. Smith and Hanson (2003) found that unemployed heads of households tend to leave their areas, as they are unable to pay for bills, including water, suggesting that people may migrate in search of employment for this reason.

2.6.5 Population group selectivity and access to water

In the context of this study, population group is fundamental, as it reflects the impact on migrant access to drinking water in SA based on race. Nleya (2008) states that poverty and inequality in South Africa are most associated with past policies of population segregation and apartheid, which promoted active deficiency of assets such as land, denying black people the opportunity to develop new assets as well as access basic services including improved water. These inequalities based on ethnic groups are still noticeable. Therefore, it can be hypothesized that population group influences access to piped water, water source, alternative water sources and reliability of water supply.

CHAPTER 3: METHODOLOGY

3.1 Introduction

Research methods are explored and discussed in this chapter. In the first part, the study area, the scope and perspective concerning the nature and type of research conducted are discussed. The second part of the chapter relates to the study design. The sampling techniques and methods of data collection were also explored. The data analysis and its stages, in terms of how the data were organised, reduced, analysed, and displayed, are conferred. Data analysis, which also involves the description of variables such as the descriptive name, position, source, and valid range of variables, constitutes an important part of this study. The procedure involving the measuring of socio-demographic, socio-economic, migratory, and water-related variables to test association is provided. In this context, the methods of hypothesis testing are explored in order to establish whether they are true or false.

3.2 Scope and perspective

The study on migration and access to water is quantitative in nature as it makes use of variables, hypothesis testing and scientific sampling. From a statistical viewpoint, little is known about the profile of migrants who access water for drinking across metropolitan and non-metropolitan areas. The study is based on socio-demographic, socio-economic, and migratory characteristics of migrant such as age, gender, employment status, income, education level, province of residence, population group, and duration of residence, to name a few.

In addition, the study focused on water-related variables such as access to piped water, water sources, reliability of water supply, and alternative water sources. Metropolitan and non-metropolitan municipalities are used as units of analysis. By bringing together the socio-demographic, socio-economic, migratory, and water-related variables, the study capture the relationship between migration and access to drinking water across metropolitan and non-metropolitan in the context of South Africa.

Migratory variables such as the duration of residence, province of birth, province of previous residence, and province of usual residence were used to understand the direction of migration and the influence it has on water access among migrants.

3.3 Research design

According to Neuman (2000), a research design can be referred to as a framework of study that is adopted to guide the gathering and analysis of data. The chosen research methods must be able to answer the research questions formulated in the study. As supported by Chikodzi

(2018), research methodology is a scheme through which a researcher can accumulate, examine, and interpret the collected data to attain the research goals and objectives.

The type of research design used in this study is cross-sectional design, as it utilised data from a population census that was conducted using a household questionnaire. The same questions were asked of all respondents in order to get information concerning their experiences regarding access to water.

The interest of the study lies in how, from a statistical viewpoint, water is accessed by migrants across metropolitan and non-metropolitan areas. By cross-tabulating migrant's characteristics and water-related variables, the researcher was able to recognise percentile differences and patterns in relation to access to piped water; different types of water source; reliability of water supply, and alternative water sources. The study identifies the areas of residence in which migrants access water easily. Statistically, the study captures a true reflection of migrants with regard to access to drinking water across the metropolitan and non-metropolitan areas of South Africa.

3.4 Data source

This study used the 2011 census data requested from Statistics South Africa (Stats SA). The reason for using this data instead of the recent 2016 Community Survey data is because the latter dataset does not cover socio-economic variables such as employment and income. The 2011 census data is the last demographic census that holds data relating to internal migration and water variables, and it offers information on all the variables required for the completion of this dissertation.

The 2011 census was due to be conducted from 9th to the 31rst October 2011. However, because the census could not be completed during this period, the date was extended to December 2011. The process of preparing the census started in 2003 and was reviewed in 2008 after the completion of the Community Survey in 2007. Methodologies and procedures were subsequently developed and tested in the form of a pilot census in 2008 and 2009 respectively. The findings from the pilot helped refine the plans and methods for a final test in 2010, which was expected to simulate the actual census, to be conducted in 2011. For this reason, the data was required to be collected in the same month as the main census (Statistics South Africa, 2012). The 2011 census, therefore, contained three files, namely person, worker, and house files. The research instrument was the individual and household questionnaire designed for the 2011 census. Personal interviews were conducted, and every household member was counted.

3.5 Data collection

The data analysis presented in this study is secondary data requested from Stats SA. The 2011 census was the third census to be conducted after the democratic elections in 1994, following after the 1996 and 2001 national censuses. The national census is a de facto population and housing census, which means that all persons are enumerated in the residence in which they spend census night. Stats SA conducted the census in all South African provinces. Each questionnaire was directed to a targeted group, for example, people in transit were interviewed in collective living quarters.

The enumerators were trained for the collection of census data. The method for data collection was canvassing, meaning face-to-face interviews were conducted with participants. Households were encouraged to allow the interviewer to complete the questionnaire; in exceptional cases, however, household members who preferred to complete these themselves were given written guides on how to do so. Although questionnaires were presented in English, guides were provided in various languages.

3.6 Description of the variables

The core purpose of this study is to identify the determinants of migrant access to water in South African households. Variables were selected according to those used in the 2011 census.

These variables were divided into four categories based on the following characteristics: socio-demographic, socio-economic, migratory, and water-related variables. The variables being analysed are categorised as follows:

3.6.1 Socio-demographic variables

The socio-demographic variables used to describe migrant characteristics include age, gender, population group, and level of education.

3.6.1.1 Age

Age is one of the most important variables used in any study on migration. The question regarding this variable was: "What is the person's age in completed years?". According to Stats SA (2011), age is the interval of time from the day, month, and year of birth, expressed as the number of years lived by an individual; in other words, a person’s age at their last birthday. In this study, however, the ages were in completed years, grouped into four categories; children (0-14 years); youth (15-35 years); adults (36-60 years); and elderly (61 years and above).

3.6.1.2 Sex/gender

The information on the 2011 census regarding "sex" referred to the personal biological status (sexual anatomy and chromosomes) and not gender. Hence, the question was: "Is the person male or female?" The answer was coded as (1) = Male and (2) = Female. This variable helped the study identify which migrant gender was likely to access drinkable water as well as which was migrating more predominantly.

3.6.1.3 Population group

This variable was used to determine the ethnic group of all persons in the household. The study assumes that migrant access to drinkable water differs according to population group. To determine this variable, the question asked was "What population group does *(name)* belong to?" Interviewers were instructed to ask everyone in the household, even if the population group might seem obvious. This variable was important because it reflects the composition of the South African population. The final code list was: (1) Black/African; (2) Coloured; (3) Indian/Asian; and (4) White.

3.6.1.4 Level of education

To determine the level of education of everyone in the household, the question asked was: "What is the level of education that (*name*) has completed?" This question was intended to establish the level of education completed, not the current level the individual was at. The final coding was: (1) no education; (2); primary education; (3) secondary education; and (4) tertiary education.

3.6.2 Socio-economic variables

This includes employment status and level of income variables.

3.6.2.1 Employment status

This variable was used to determine which members of the household were employed, unemployed, or not economically active, based on employment status in the seven days prior to the survey interview. To achieve this, the enumerators were instructed to ask this set of questions to household members aged 15-64 years. The concept of employment included a regular job, casual job, contract, or any other type of work or business. Those who did not have a job were then asked whether they were actively looking for one. The categories were: (1) employed; (2) unemployed; and (3) not economically active.

3.6.2.2 Level of income

This variable was used to determine the level of income of household members based on their income categories. The respondents were asked: "What is the income category that best describes the gross annual or monthly income of *(name)* before deductions and including all sources of income?" The participant was given a list of categories to choose from, recording their answer either annually or monthly. However, for the purpose of this study, income was recorded monthly. The final recording was: (1) = no income; (2) = R1-R400; (3) = R401-R800; (4) = R801-R1600; (5) = R1601-R3200; (6) = R3201-R6400; (7) = R6401-R12800; (8) = R12801-R25600; (9)= R25601-R51200; (10) = R51201-R102400; (11) = R102401-R204800; (12) = R204801 or more, and (13) = unspecified. In this study, these details were recorded into three categories: (1) = no income; (2) = low income; and (3) = high income.

3.6.3 Migratory variables

This consists of province of birth, province of previous residence, province of current residence, and duration of stay.

3.6.3.1 Province of birth

The question: "In which province was *(name)* born?" was asked. The interviewers were trained to capture this information according to current province titles, not past titles. The code list was: (1) Western Cape; (2) Eastern Cape; (3) Northern Cape; (4) Free State; (5) KwaZulu-Natal; (6) North West; (7) Gauteng; (8) Mpumalanga; (9) Limpopo; and (13) outside South Africa.

3.6.3.2 Province of previous residence

To determine the province from which a responded has moved, the following question was asked: "In which province did (*name*) live before this dwelling?" The final record was: (1) Eastern Cape; (2) Western Cape; (3) Northern Cape; (4) Free State; (5) Kwazulu-Natal; (6) Northern West; (7) Gauteng; (8) Mpumalanga; (9) Limpopo; (10) outside RSA; and (11) do not know.

3.6.3.3 Province of usual residence

The question: "In which province does (*name*) usually live?" was asked of the respondents in order to determine the province in which they usually reside. The final code list was: (1) Eastern

Cape; (2) Western Cape; (3) Northern Cape; (4) Free State; (5) Kwazulu-Natal; (6) Northern West; (7) Gauteng; (8) Mpumalanga; (9) Limpopo; (10) outside RSA; and (11) do not know.

3.6.3.4 Duration of residence

The variable "duration of residence" was created to examine the period in which migrants lived in a destination area. However, there was no direct question to the participant regarding the duration of their residence. The variable was created in Statistical Package for the Social Sciences (SPSS) using the year/s in which the person moved in. The question: "In which year and month did the person move to this dwelling?" was used to compute the variable "duration of residence"

3.6.3.5 Residence lived past five years

This question helped to capture whether a person a migrant or not. The question "Was the person living in this dwelling in October 2001?" was asked to find out whether the person was living in the same dwelling from October 2001. This question refers to any movements, no matter how close from the original place to the new one. This also includes movement from one dwelling unit to another, even on the same stand or in the same block of flats. The responses were recorded as: (1) Yes, (2) No, (3) Born after October. If the person answers "Yes" it means there was a movement. In the context of this study, the person was automatically recorded as migrant.

3.6.4 Area of residence

The problem with this variable, however, is as regards to the concept of urban/rural. This variable was not used explicitly in the 2011 Census. However, the absence of this variable did not, as such, affect the results of the study. The perspective was rather on a different level of analysis as previously mentioned. In fact, the urban area is said to be comprised of places of different sizes and functions. This is the case for metropolitan and non-metropolitan municipality areas. This definition of the politico-economic space eliminated the distinction between rural and urban areas that were historically reported in the data collected by Stats SA. This is one of the reasons why this study was not driven by the concern of proving migration information in rural and urban areas. As a result, a new variable "area of residence" was rather computed in SPSS by means of "area count menu". This was performed by compressing the data of all metropolitan municipalities to make "metropolitan area" as category (1); all district

and local municipality data to make “non-metropolitan area” as category (2) (Nsengiyumva, 2013).

3.6.5 Water-related variables

This includes water variables such as piped water, water sources, alternative water sources, and reliability of water supply.

3.6.5.1 Access to piped water

This variable was used to identify different ways in which migrants access piped water for household use. The question excludes water used for non-domestic purposes, for example, water used for gardens or cattle. The question asked was: “In which way does this household mainly get piped water for household use?” The final coding was: (1) piped water inside the dwelling; (2) piped water inside the yard; (3) piped water on community stand: distance less than 200m from dwelling; (4) piped water on community stand: the distance between 500m and 200m from dwelling; (5) piped water on community stand: the distance between 500m and 1km from dwelling; (6) piped water on community stand: distance greater than 1km from dwelling; and (7) no access to piped water.

3.6.5.2 Water source

This variable was used to identify sources that migrants use for accessing drinkable water. The question asked was: "What is the household's main source of water for drinking?" The question focused on water used only for consumption. The final category included (1) regional/local water scheme; (2) borehole; (3) spring; (4) rainwater tank; (6) dam/pool/stagnant water; (7) river/stream; (8) water vendors; (9) water tanker; and (10) other.

3.6.5.3 Alternative water source

This variable was used to identify alternative water sources in case of interruption to the piped water supply for longer than two days. To achieve this, the question: "What alternative source did the household use during water supply interruption?" was asked. The final coding was: (1) none; (2) borehole; (3) spring; (4) rainwater tank; (5) dam/pool/stagnant; (6) river/stream; water vendor; (7) water tanker; and (8) other.

3.6.5.4 Reliability of water supply

This variable was used to explore the level of reliability of water supply among migrants. The question: “In the last 12 months, has this household had any interruptions to the piped water supply?” was asked to examine the reliability of water supply in migrant households. The final coding regarding this question was: (1) yes; and (2) no.

3.7 Methods of data analysis

The primary objective of data analysis is to compare observed findings with expected findings. To perform the data analysis, the use of a computer was helpful because of the large data set and a number of variables. SPSS version 25 was used for this purpose.

The univariate, bivariate, and multivariate statistical methods were used to analyse the data. The univariate analysis, such as descriptive statistics, was used to explore the dataset. The bivariate analysis, using cross-tabulation and chi-square test statistics, was used to test the association between the independent and dependent variables discussed in this study. Multivariate analysis using logistic regression was also utilised to identify factors contributing to water access among migrants across metropolitan and non-metropolitan areas. To determine whether there is a relationship between two variables, a p-value of less than 0.05 (<0.05) was considered.

3.7.1 Univariate analysis

Univariate analysis is one of the methods used to analyse data using a single variable. It summarises the data and calculates the pattern of percentages. Descriptive statistics is used in this study specifically to show the distribution and values of particular variables through frequency tables and graphs.

3.7.2 Bivariate analysis

Because of its examination of only single variables, the use of univariate analysis alone was not sufficient to answer the research questions and objectives of the study. Therefore, bivariate analysis was included. This type of data analysis is used to establish if there is a relationship between independent and dependent variables. The results can be displayed in a two-way table (cross-tabulation) to display the patterns of percentages.

3.7.2.1 Chi-square

Chi-square test statistics compares two variables in a contingency table to measure if they are related or different from each other. If the p-value is less than the cut-off value of 0.05, it suggests that there is a significant relationship between the variables. In this case, the hypothesis is supported by the findings. Conversely, if the p-value is greater than the value of 0.05, this shows that the relationship between the variables is not significant, and the hypothesis is rejected.

The formula for Chi-square test statistic:

$$\chi_c^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

3.7.3 Multivariate analysis

After performing bivariate analysis, multivariate analysis was used to create a model, which includes more than two variables. In this regard, logistic regression was used because all the variables were categorical in nature.

3.7.3.1 Logistic regression

With regard to logistic regression, the independent variables were simultaneously included in the model. The Hosmer-Lemeshow goodness-of-fit test informs on how closely observed and predicted probabilities match. In this case a $p>0.05$ indicates that the model fits the data. In addition, 5 percent was used as a level of significance cut-off point. Nsengiyumva (2013) saw that if the Hosmer-Lemeshow goodness-of-fit test statistic is greater than 0.05, as is desired for well-fitting models, it implies that the model's estimates fit the data at an acceptable level.

With regard to the variables in the equation table, any variable with a $p<0.05$ was considered significant, as were variables with a 0.06 value. The argument here to note is that this is different from the Hosmer Lemeshow, which provides a $p>0.05$. The Wald estimate provides the importance of the contribution of each variable in the model. The higher the value, the more important it is. The Exp (B) gives the odds ratios; in other words, it gives the likelihood that an event will occur.

According to Nsengiyumva (2013), the equation of the model is:

$p(y = 1) = \frac{exp\,(z)}{1+exp\,(z)}$ where $z = b_0 + b_1x_1 + \cdots + b_nx_n$

Estimated model $\hat{p}(y=1) = \frac{exp\ (\hat{z})}{1+exp\ (\hat{z})}$ $\hat{z} = \hat{b}_0 + \hat{b}_1 x_1 + \cdots \hat{b}_n x_n$

Where $\hat{b}_i$ are derived b maximum likelihood estimation. $b_0, b_1 \ldots\ldots, b_n$ are regression coefficients, where b_i is changed in log-odds of $y = 1$ (the events happening) for a unit change in x_i with other independent variables held constant.

Equivalently, $exp\ (b_i)$ is a change in odds of $y = 1$ (the event happening) for a change in x_i. When x_i is a binary variable, $exp\ (b_i)$ is the change in odds of $y = 1$ where x_i changes from 0 to 1, where $x_i = 0$ is treated as a reference category (Nsengiyumva, 2013).

CHAPTER 4: STUDY FINDINGS

4.1 Introduction

This chapter focuses on the analysis of the data collected during the 2011 Census requested from Statistics South Africa. This study aims to examine the relationship between migrants' characteristics such as age, gender, population group, level of education, employment status, income, province of previous residence, province of birth, duration of residence, and access to water by looking at access to piped water, water sources, alternative water sources, and water reliability in the context of South Africa.

The analysis starts with a univariate analysis to assess the magnitude and characteristics of migrants and to show the distribution. Bivariate analysis was used to test the relationship between dependent and independent variables using a Chi-square statistical test. Independent variables consist of: population group, age group, level of education, employment status, level of income, province of previous residence, duration of residence, and the province of usual residence. To measure the strength of association, the study used Lambda, Cramer's V, and Phi. Multivariate analysis using logistic regression was used to highlight the factors contributing to access and water sources.

4.2 Sample composition

The study focuses on internal migrants and the manner in which they obtain water for household use across metropolitan and non-metropolitan areas in South Africa. The survey results are portrayed in Table 4.1 below. The survey results show a total number of 20482 internal migrants enumerated in the 2011 Census. The results indicate that Black/African and Whites were the population groups with most migrants, with 49.9% and 40.4% respectively. Coloureds were the smallest population group involved in migration, with only 4.5% of its population migrated.

The results indicate the imbalance between genders, males having to migrate more (68.3%) than females (31.7%). Adult and young migrants appear to be more migration-prone than children and elderly people. With regards to the level of education, most migrants completed at least secondary school (63.0%), followed by migrants with tertiary education (26.8%). People with primary and those with no formal education are less likely to migrate (6.9% and 3.3% respectively). Furthermore, the findings reveal that most of these migrants were employed (76.7%) with high incomes (49.1%)

Table 4.1: Frequency distribution

Population group	Frequency	Percentages
Black/African	10226	49.9
Coloured	926	4.5
Indian/Asian	1060	5.2
White	8270	40.4
Total	20482	100.0
Gender		
Male	13990	68.3
Female	6492	31.7
Total	20482	100.0
Age group		
Children	16	0.1
Youth	8863	43.3
Adults	10342	50.5
Elderly	1261	6.2
Total	20482	100.0
Level of education		
No schooling	666	3.3
Primary school	1423	6.9
Secondary school	12898	63.0
Tertiary education	5495	26.8
Total	20482	100.0
Level of income		
No income	2920	14.3
Low income	7513	36.7
High income	10049	49.1
Total	20482	100.0
Employment status		
Employed	15701	76.7
Unemployed	1640	8.0
Not economically active	3141	15.3

Source: 10% of the 2011 Census data

4.3 Fixed-term migration

To get the fixed-term migration, Table 4.2 below illustrates the direction of migration from the province of previous residence and the province of usual residence. The findings indicate that a large number of migrants are from Limpopo to Gauteng (40.6%), followed by migrants from Eastern Cape to the Western Cape (13.90%). Kok *et al.,* (2003) also found that out of all metropolitan regions, Gauteng is the main source and destination of migrants in and outside of South Africa. Both Gauteng and the Western Cape provinces attract many migrants, as they are the centre of the economy in the country. The findings also indicate that provinces located in regions with no metropolitan municipalities, such as Limpopo and Mpumalanga, have more people moving out of the province than moving in. Conversely, the highly urbanised provinces like Gauteng and Western Cape experience more immigration than emigration.

Table 4.2: Distribution of migrants by province of previous residence and province of usual residence

Province of previous residence	Province of usual residence									Total
	WC	EC	NC	FS	KZN	NW	GP	MP	LP	
WC	1920	91	15	21	39	36	294	15	31	2462
	77.3%	3.7%	0.6%	0.8%	1.6%	1.4%	11.85%	0.6%	1.2%	100%
EC	247	847	12	29	148	34	364	19	43	1743
	13.90%	47.8%	0.7%	1.6%	8.4%	1.9%	20.6%	1.1%	2.4%	100%
NC	40	6	120	14	10	16	101	6	13	326
	12.2%	1.8%	36.6%	4.3%	3%	4.9%	30.8%	1.8%	4%	100%
FS	59	22	7	324	25	30	210	10	46	733
	8%	3%	0.9%	43.7%	3.4%	4%	28.3%	1.3%	6.2%	100%
KZN	135	83	16	24	1452	30	612	41	54	2447
	5.4%	3.3%	0.6%	1%	58.5%	1.2%	24.7%	1.7%	2.2%	100%
NW	34	35	16	21	28	420	260	17	42	873
	3.8%	4%	1.8%	2.4%	3.2%	47.5%	29.4%	1.9%	4.8%	100%
GP	364	115	19	60	232	152	6647	122	430	8141
	4.4%	1.4%	0.2%	0.7%	2.8%	1.8%	80.8%	15%	5.2%	100%
MP	36	74	7	17	35	21	233	333	38	794
	4.5%	9.2%	0.9%	2.1%	4.4%	2.6%	29%	41.4%	4.7%	100%
LP	54	30	3	14	28	43	526	54	524	1276
	4.2%	2.3%	0.2%	1.1%	2.2%	3.3%	40.6%	4.2%	40.1%	100%
Out SA	239	79	9	22	148	56	713	52	117	1435
	16.4%	5.4%	0.6%	1.5%	10.2%	3%	48.9%	3.6%	8%	100%
Total	3128	1382	224	546	2145	838	9960	669	1338	20230
	15.3%	6.7%	1.1%	2.7%	10.5%	4.1%	48.6%	3.3%	6.5%	100%

Source: 10% of the 2011 Census data.

WC: Western Cape; EC: Eastern Cape; NC: Northern Cape; FS: Free State; KZN: KwaZulu-Natal; NW: North West; GP: Gauteng Province; MP: Mpumalanga; LP: Limpopo; Out SA: Outside South Africa

4.4 Life-time migration

Table 4.2.1 below shows the lifetime migration by cross-tabulating the province of place of birth and province of usual residence. It is indicated from the findings that migrants are more likely to leave their provinces of birth to Gauteng and the Western Cape. However, it is migrants born in Limpopo who are more likely to relocate to Gauteng (56.2%), whereas most migrants in the Western Cape are born in the Eastern Cape (21.8%). Other provinces receive small numbers of immigrants. The findings further indicate that Gauteng and the Western Cape receive more migrants from outside South Africa than any other province.

Table 4.2.1: Province of birth and province of usual residence

Province of place of birth	Province of usual residence									
	WC	EC	NC	FS	KZN	NW	GP	MP	LP	Total
WC	1105	48	11	15	33	23	292	16	23	1566
	70.0%	3.0%	0.7%	0.9%	2.1%	1.5%	18.5%	1.0%	1.5%	100 %
EC	485	827	6	40	157	56	565	29	50	2215
	21.8%	37.2%	0.3%	1.8%	7.1%	2.5%	25.4%	1.3%	2.2%	100 %
NC	84	12	105	25	23	24	170	12	17	472
	17.7%	2.5%	22.1%	5.3%	4.8%	5.1%	35.8%	2.5%	3.6%	100 %
FS	113	39	14	284	48	63	420	24	63	1068
	10.5%	3.6%	1.3%	26.4%	4.5%	5.9%	39.1%	2.2%	5.9%	100 %
KZN	156	64	14	24	1176	30	1003	40	57	2564
	6.1%	2.5%	0.5%	0.9%	45.7%	1.2%	39.0%	1.6%	2.2%	100 %
NW	39	20	20	13	20	304	457	31	58	962
	4.0%	2.1%	2.1%	1.3%	2.1%	31.5%	47.3%	3.2%	6.0%	100 %
GP	399	81	12	62	195	113	3239	90	201	4392
	9.0%	1.8%	0.3%	1.4%	4.4%	2.6%	73.4%	2.0%	4.6%	100 %
MP	38	43	4	5	36	25	439	238	51	879
	4.3%	4.9%	0.5%	0.6%	4.1%	2.8%	49.5%	26.9%	5.8%	100 %
LP	40	21	4	10	15	41	885	58	498	1572
	2.5%	1.3%	0.3%	0.6%	1.0%	2.6%	56.2%	3.7%	31.6%	100 %
Outside SA	645	210	30	58	413	151	2397	125	310	4339
	14.9%	4.8%	0.7%	1.3%	9.5%	3.5%	55.2%	2.9%	7.1%	100 %
Total	3104	1365	220	536	2116	830	9867	663	1328	20029
	15.5%	6.8%	1.1%	2.7%	10.6%	4.1%	49.3%	3.3%	6.6%	100 %

***Source**:* 10% of the 2011 Census data.

WC: Western Cape; EC: Eastern Cape; NC: Northern Cape; FS: Free State; KZN: KwaZulu-Natal; NW: North West; GP: Gauteng Province; MP: Mpumalanga; LP: Limpopo; Out SA: Outside South Africa

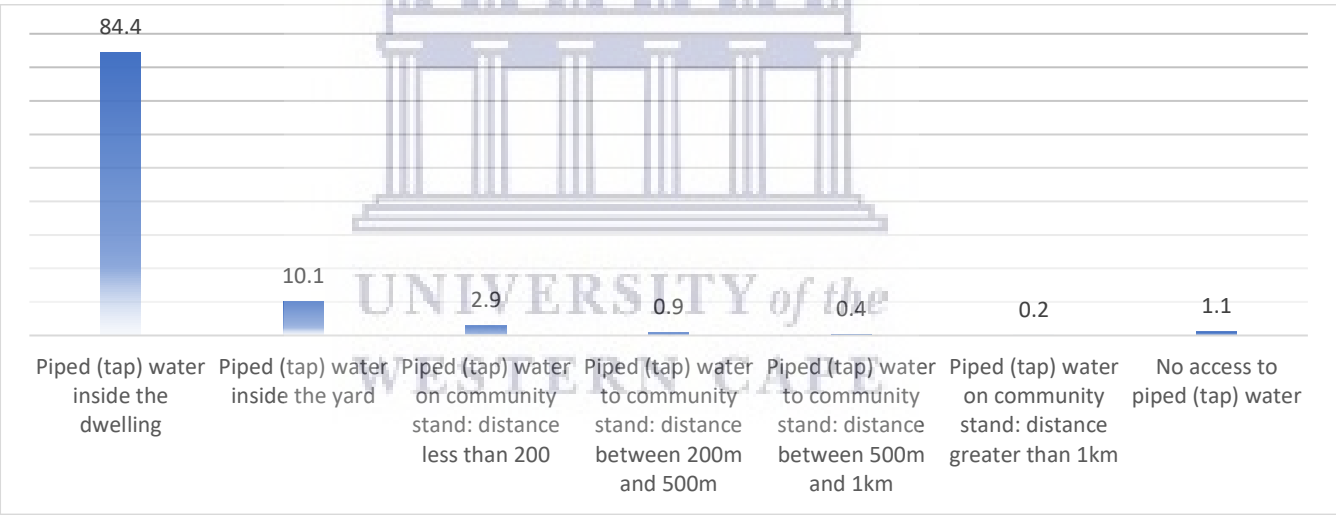
4.5 Access to piped water for consumption across areas of residence

The study examined migrants' access to piped water both in metropolitan and non-metropolitan areas.

4.5.1. Migrants' access to piped water in metropolitan areas

As shown in Fig. 4.1 below, it is indicated that migrants from metropolitan areas are likely to have access to piped water inside the dwelling (84.4%). This is followed by access inside the yard (10.1%), whereas there are fewer migrants accessing piped water from community stands. This is a good indication that people in metropolitan areas, particularly migrants, have better access to piped water and do not have to travel long distances to access water. This supports the argument by the literature that in the past two decades access to piped water in developing countries has improved (Barde, 2017).

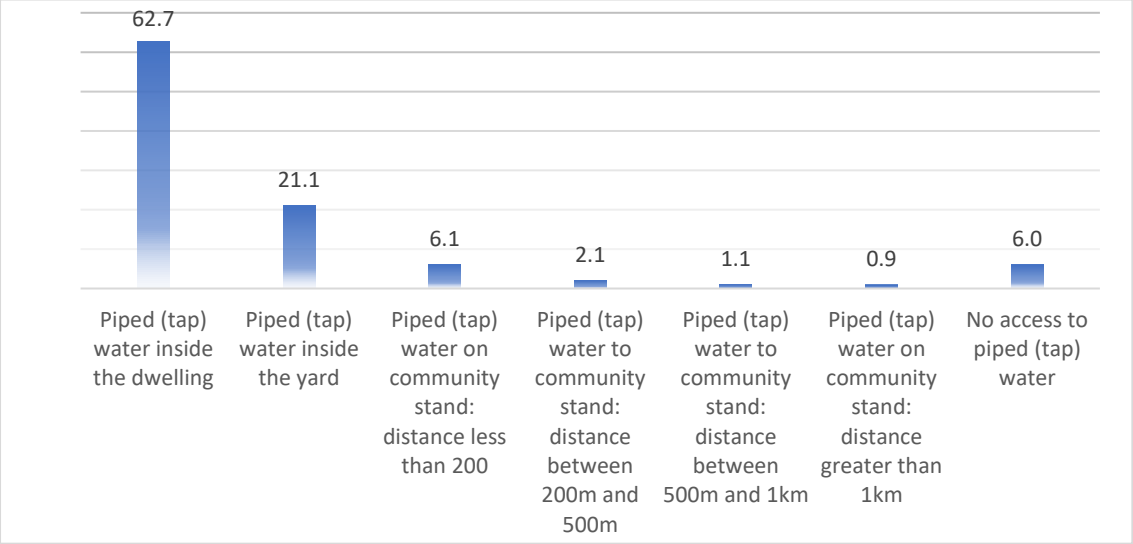
Fig. 4.1: The distribution of access to piped water in metropolitan areas



4.5.2 Migrants' access to piped water in non-metropolitan areas

The results in figure 4.2 below confirm that the majority of migrants in non-metropolitan areas are also accessing piped water inside their dwellings and yards: 62.7% and 21.1% respectively. However, the findings also show an alarming number of migrants having no access to piped water (6%) and those having to travel for distances less than 200 metres (6.1%) to access community stands.

Fig. 4.2: The distribution of access to piped water in non-metropolitan areas



4.6 Migrants' access to piped water across metropolitan municipalities

This section provides information on migrants' access to piped water across metropolitan municipalities of South Africa. The analysis to this end reveals that migrants in the City of Johannesburg and City of Tshwane (both in Gauteng) have the greatest rate of access to piped water inside the dwelling/premise (34.4% & 20.7% respectively), followed by the City of Cape Town with 17.6%. These are the biggest cities of the country; hence they have improved services and infrastructure. Consequently, South Africa is rapidly urbanising as large number of people are migrating to these industrialised cities in pursuit of better amenities, such as access to safe drinking water in their premises (Mlambo, 2018). Conversely, the findings show that other metropolitans like Buffalo City, Nelson Mandela Bay, Mangaung, and eThekwini have small proportions of people accessing piped water inside their dwellings. The primary reason for these disparities might be that there is not much development in infrastructure and service delivery as compared to the ones situated in urban regions. Even though this is the case, the findings also show that there are a large number of people lacking access to piped water in Tshwane and the City of Johannesburg: 36% and 31.1% respectively. This is because these cities have high numbers of migrants who contribute to the demands in public services such as the provision of piped water. Also, a remarkable number of migrants in these areas are likely to live in informal settlements where there is no formal provision of services.

Chi-square test statistics were used to test for the association between access to piped water and metropolitan municipalities. The findings show a p-value of 0.000 between the two

variables above mentioned. Since the p-value of 0.000 is less than 0.05, the test statistic was significant. This means that there is a relationship between migrants' access to piped water and the metropolitan areas they choose to go to.

Table 4.3 Access to piped water across individuals in metropolitan regions (%)

Access to piped water	CPT	Buffalo City	N.M Bay	Mangaung	eThekwini	Ekurhuleni	JHB	Tshwane	Total
Inside the dwelling	17.6	1.6	1.6	1.4	8.3	12.2	36.4	20.7	100%
Inside the yard	12.8	1.4	0.6	3.6	6.9	17.5	39.4	17.8	100%
>200m	19.8	2.4	0.7	3.1	18.1	12.6	29.6	13.6	100%
200m & 500m	10.0	2.3	0.8	0.8	8.5	18.5	40.8	18.5	100%
>500m	21.4	1.8	1.8	0.0	17.9	23.2	21.4	12.5	100%
500m-1km	25.0	0.0	4.2	4.2	12.5	25.0	12.5	16.7	100%
No access	7.3	4.3	1.8	1.2	11.0	7.3	31.1	36.0	100%

Source: 10% of the 2011 Census data

CPT: City of Cape Town; N.M Bay: Nelson Mandela Bay; JHB: City of Johannesburg

4.7 The demographic and socio-economic characteristics of migrants and access to piped water

Accessibility of drinkable water can vary across metropolitan and non-metropolitan regions in respect of socio-demographic, socioeconomic, and migratory characteristics of the migrants. To support this hypothesis, Dungumaro (2007) argues that accessibility and affordability of consumable water is determined by various factors, including socioeconomic status of households.

4.7.1 Piped water by level of education across areas of residence

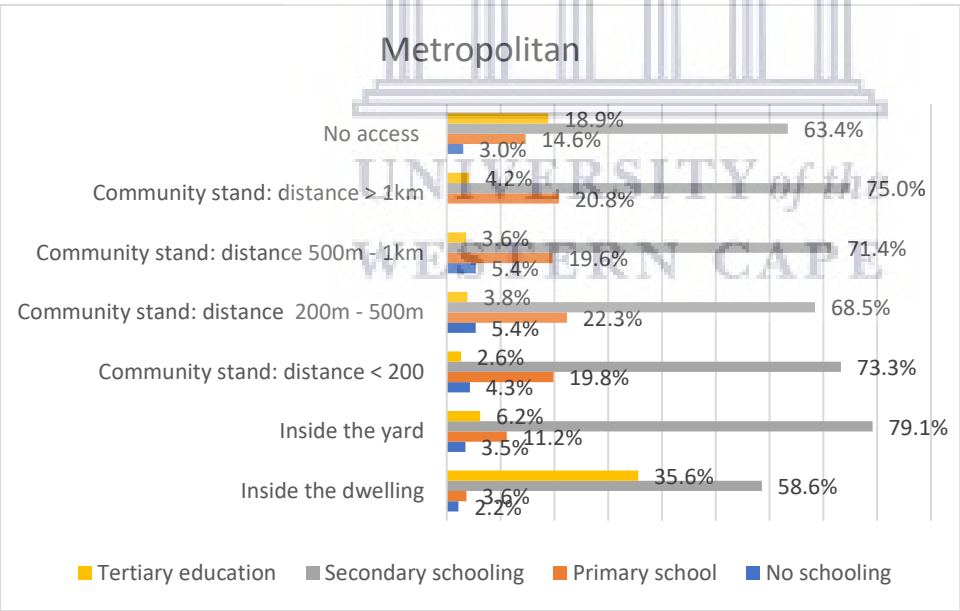
4.7.1.1 Access to piped water by level of education in metropolitan areas

The study analysed the findings by cross-tabulating data about access to piped water in metropolitan areas and level of education. The expectation is that households headed by educated migrants would have comparatively better access to piped water than other migrants. As portrayed in figure 4.3.1, the results show that the households headed by migrants with secondary and tertiary education have more access to piped water inside the premises and yards

in metropolitan areas than households headed by migrants with primary or no formal education. The findings also show that migrants with primary education and those with no schooling are most likely to access piped water from the community stand pipes at a distance less than 200 metres and up to 1 kilometre.

A Chi-square test statistic was performed to examine the association between access to piped water and migrants' level of education in metropolitan areas. The findings indicate a p-value of 0.000 between piped water and level of education. Therefore, since the p-value of 0.000 is less than 0.05, the test statistic was significant. This means that there is a significant relationship between migrants' access to piped water and level of education. In other words, migrants' level of education may influence the access to piped water in metropolitan areas. Furthermore, the Phi and Cramer's V, and Lambda were used to measure the strength of the relationship between the above variables. The findings showed a very weak relationship (0.000) between migrants' access to piped water and their level of education.

Fig. 4.3.1 Distribution of piped water by level of education in metropolitan areas

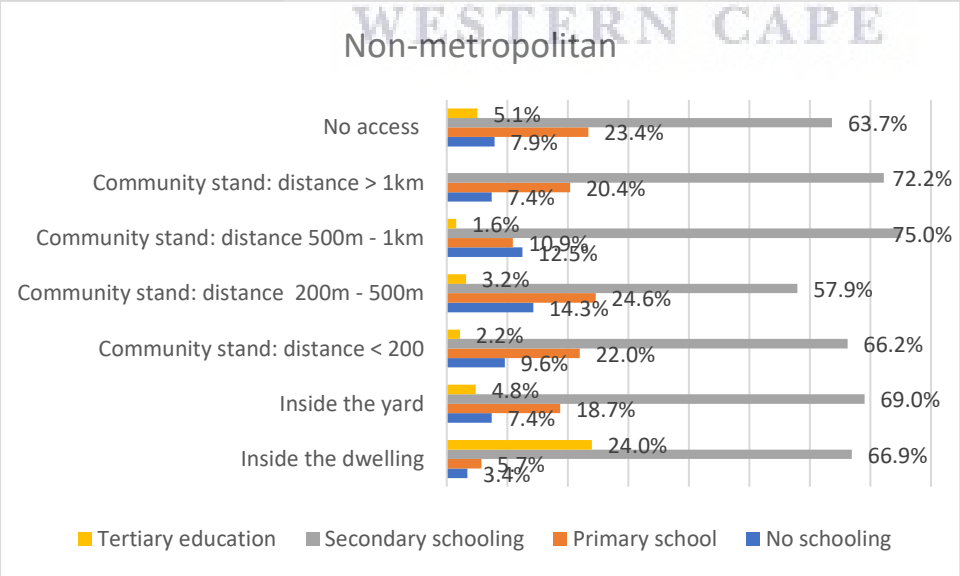


4.7.1.2 Access to piped water by level of education in non-metropolitan areas

The findings in Figure 4.3.2 below indicate that the households headed by migrants with secondary and primary education have generally the most access to piped water than migrants with tertiary education and those with no schooling. However, the findings show that migrants with tertiary education in non-metropolitan areas have access to piped water inside their premises (24%) more than they do with piped water inside their yards or in community stands. Migrants with no schooling are most likely to have access to piped water from community stand pipes at considerable distances.

Chi-square test statistics was used to assess the relationship between access to piped water and migrants' level of education in non-metropolitan areas. The findings showed a p-value of 0.000 between piped water and level of education. Thus, since the p-value of 0.000 is less than the value of 0.05, the test statistic was significant. This means that there is a relationship between migrants' access to piped water and level of education in non-metropolitan municipalities. To measure the strength of the relationship between the variables in non-metropolitan areas, the Lambda, Phi and Cramer's V tests were used. Lambda (0.297) showed a moderate association while Phi and Cramer's V (both 0.000) showed a very weak relationship.

Fig. 4.3.2 Distribution of piped water by level of education in non-metropolitan areas



4.7.2 Piped water by population groups across areas of residence

4.7.2.1 Access to piped water by population groups in metropolitan areas

To examine the inequality in access to piped water across ethnic groups in metropolitan areas, the study cross-tabulated piped water and migrants' population groups. The findings show that Black migrants have most access to piped water in metropolitan areas. However, White migrants have more access to piped water inside the dwellings (48.1%). Given the fact that the white population in South Africa accounts only 8.9% of the total population (StatsSA, 2011), the findings suggest that white migrants have high chances of accessing improved water sources than other migrants of different population groups. Coloureds and Indian/Asian migrants have less access to piped water, which may be influenced by their proportion, as they make up a smaller proportion of the total population of the country.

To test the relationship between piped water and migrants' population groups, the study used a Chi-square test statistic. The findings indicate a p-value of 0.00, which is less than a standard value of 0.05. This means that there is statistical evidence that the relationship exists between access to piped water and migrants' population group in metropolitan areas. This implies that migrants' population group can determine their access to piped water in metropolitan areas. To measure the strength of the association between piped water and population group, Lambda, Phi and Cramer's V tests were used. All the tests showed no strength between the variables (0.000).

4.7.2.2 Access to piped water by population groups water in non-metropolitan areas

It is evident from the findings that there are discrepancies in access to piped water in non-metropolitan areas with regards to population group. The results portray that White migrants living in non-metropolitan areas have greater access to piped water inside their dwellings than any other population group, scoring 55.5%, followed by Black migrants with 37.1%. Indian/Asian are less likely to access piped water inside their dwellings, scoring only 3%. The study has indicated that Coloured and Indian/Asian migrants do not go further than 500 metres to a kilometre to fetch piped water from a community water point, as compared to 90.6% of Black migrants and 9.4% of White migrants.

A Chi-square test was used to examine the relationship between access to piped water and migrants' population groups in non-metropolitan areas. The findings illustrate a p-value of 0.00. Therefore, since the p-value is less than 0.05, statistically, there is a significant relationship between these two variables. This means that accessing piped water in non-metropolitan areas might depend on one's ethnic group. To measure the strength of the association between the variables, the study used Lambda, Phi and Cramer's V and the findings showed a very weak association (0.000).

Table 4.4 Distribution of piped water by population group in metropolitan and non-metropolitan regions

Metropolitan					Non-metropolitan			
Piped water	**Black/African**	**Coloured**	**Indian/Asian**	**White**	**Black/African**	**Coloured**	**Indian/Asian**	**White**
Inside the dwelling	39.4%	5.3%	7.2%	48.1%	37.1%	4.4%	3.0%	55.5%
Inside the yard	88.8%	2.6%	1.3%	7.2%	90.3%	3.4%	1.4%	5.0%
Community stand: less than 200m	92.6%	1.4%	0.7%	5.3%	92.9%	1.6%	2.2%	3.3%
Community stand: Btwn 200m-500m	86.2%	0.8%	3.1%	10.0%	93.7%	1.6%	0.8%	4.0%
Community stand: Btwn 500m-1km	83.9%	7.1%	1.8%	7.1%	90.6%	0	0	9.4%
Community stand: Greater than 1km	95.8%	0	0	4.2%	87.0%	5.6%	0	7.4%
No access	81.1%	1.2%	0.6%	17.1%	85.1%	2.5%	2.8%	9.6%

Source: 10% of the 2011 Census data

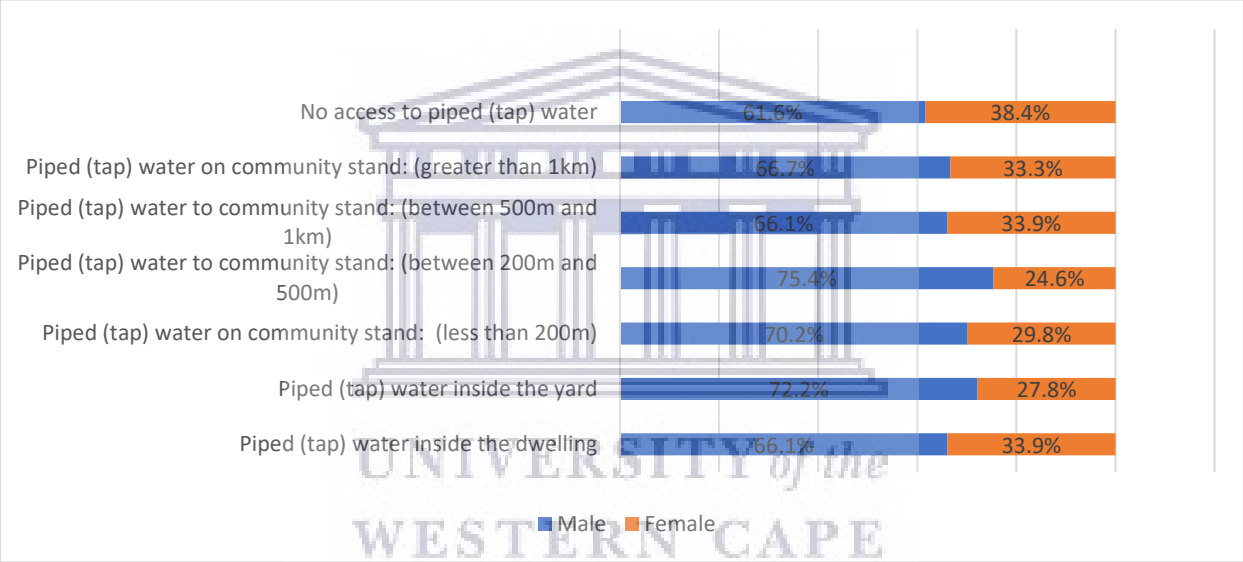
4.7.3 Piped water by gender accross areas of residence

4.7.3.1 Access to piped water by gender in metropolitan areas

Gender can be an important variable that can influence access to scarce resources, including water. To examine this argument, cross-tabulation was performed between the factors of access to piped water in metropolitan regions and gender. The results show that male migrants have greater access to piped water than their female counterparts. 66% of males had access to piped water inside their dwellings while only 34% of females accessed piped water inside their houses. This implies that there are still imbalances in gender with regards to access to services.

To examine the association between access to piped water and gender difference in metropolitan areas, the study has performed a Chi-square statistical test. The findings showed a p-value of 0.000 between access to piped water and gender. As the p-value of 0.000 is less than the value 0.05, we can statistically conclude that there is a significant relationship between piped water access and gender differences in metropolitan areas. In other words, these results indicate that there are differences in access to piped water based on gender in metropolitan areas. The study used Lambda, Phi and Cramer's V to measure the strength of the relationship between piped water and gender in metropolitan areas. The findings confirm a very weak relationship (0.000).

Fig. 4.3.3 Distribution of piped water by gender in metropolitan

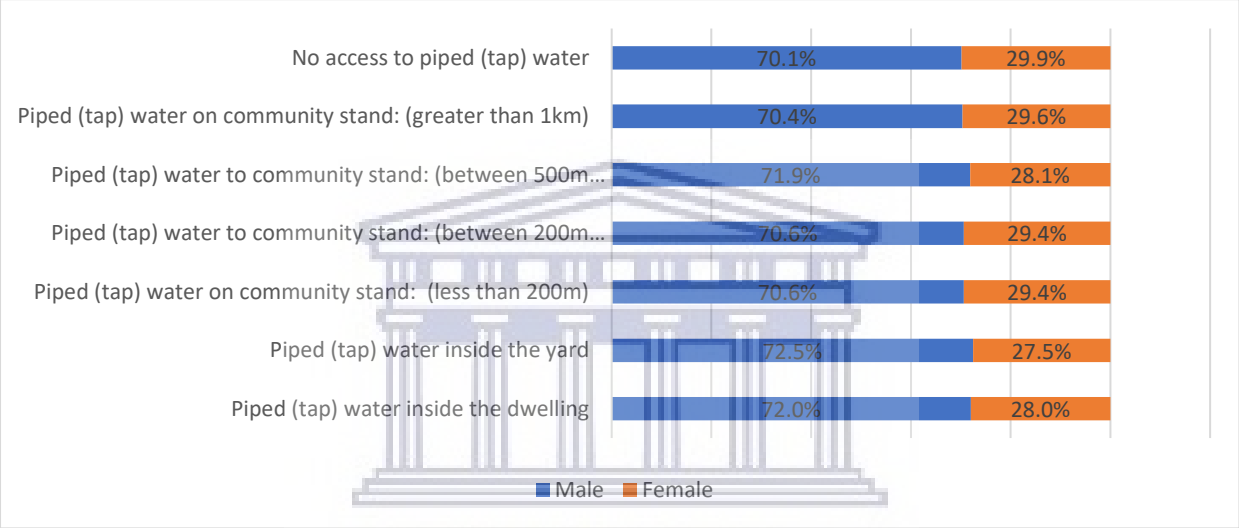


4.7.3.2 Access to piped water by gender in non-metropolitan areas

Looking at gender in non-metropolitan areas, the study has cross-tabulated access to piped water and gender of migrants. Just like in the metropolitan areas, the findings show disparities in access to piped water between male and female migrants in non-metropolitan areas. Males have more access to piped water, from inside the dwellings to community stands, than their female counterparts.

The study has performed a Chi-square statistical test to examine the association between access to piped water and gender differences in non-metropolitan areas. The output showed a p-value of 0.975 between access to piped water and gender. Since the p-value of 0.975 is greater than the value of 0.05, we have enough statistical evidence that there is no significant relationship between access to piped water and gender in non-metropolitan areas. This implies that access to piped water in non-metropolitan areas is not determined by gender differences.

Fig. 4.3.4 Distribution of piped water by gender in non-metropolitan



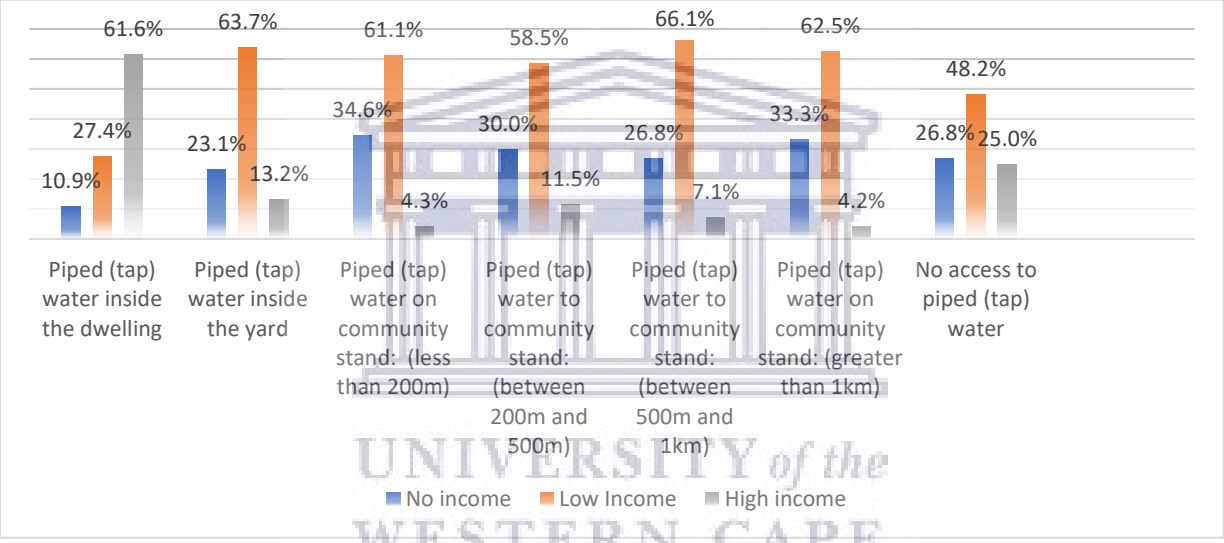
4.7.4 Piped water by level of income across areas of residence

4.7.4.1 Access to piped water by level of income in metropolitan areas

Income is a very important factor that contributes to our lifestyle including access to water for consumption. Looking at the access to piped water inside the dwelling, the findings show that migrants with a high level of income are most likely to access piped water (62%) than migrants with low or no income (27% and 11% respectively). However, the findings show that in other categories the number of migrants with a high level of income accessing piped water decreased and those with low income increased. Migrants with low income in metropolitan areas are more likely to access piped water inside the yard (64%), followed by those with no income (23%). Furthermore, the findings show that migrants with high income are less likely to fetch water from sources far from their dwellings.

To examine the relationship between migrants' level of income and access to piped water in metropolitan areas, the study used the Chi-square test statistic. The Chi-square test output indicates a p-value of 0.000, which is less than the standard value of 0.05. Since the p-value is less than the standard value of 0.05, we have a statistical evidence that there is a significant relationship between migrants' level of income and access to piped water in metropolitan areas. This implies that level of income can increase the chances of migrant in accessing piped water. To measure the strength of the association, the study used Lambda, Phi and Cramer's V tests. The findings reveal very weak association (0.000) between piped water and level of income in metropolitan areas.

Fig. 4.3.5 Distribution of piped water by level of income in metropolitan areas

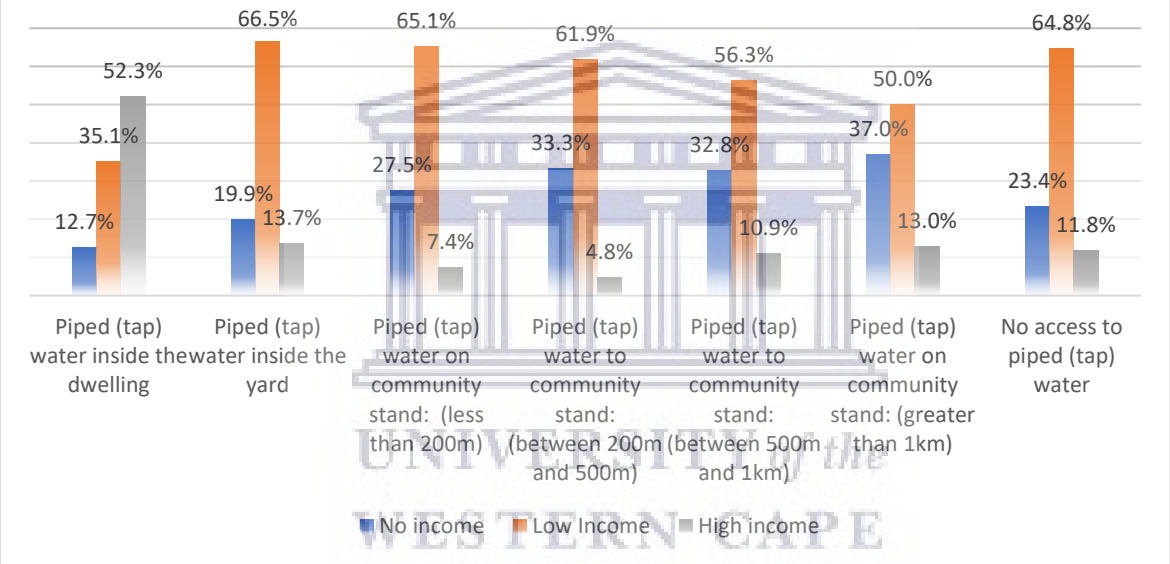


4.7.4.2 Access to piped water by level of income in non-metropolitan areas

The findings below in Fig. 4.3.6 show the distribution of migrants' access to piped water in non-metropolitan areas. It is evident from the results that migrants with high levels of income are more likely to access piped water inside their dwellings (52%) than migrants with low and no income, with only 35% and 13% respectively. This might be based on the affordability in water prices, hence those with high income are much likely to have tap water inside their houses than those with little or no income at all. The findings indicate that migrants with less or no income are more likely to access piped water from taps inside their yards and community stands at remarkable distances. Also, the findings show that migrants with higher level of income are more likely to have access to piped water as compared to migrants with less or no income.

A Chi-square test was used to test the association between migrants' levels of income and access to piped water in non-metropolitan areas. The findings show a p-value of 0.000 which is less than the standard value of 0.05. Therefore, since the p-value is less than 0.05 there is enough statistical evidence to confirm that there is a significant relationship between migrants' level of income and access to piped water in non-metropolitan areas. This suggests that the level of income can determine the migrants' access to piped water in non-metropolitan areas. The study used Lambda, Phi and Cramer's V to measure the strength of the association between these two variables. All the tests showed a very weak association (0.000) between the two variables.

Fig. 4.3.6 Distribution of piped water by level of income in non-metropolitan areas



4.7.5 Piped water by employment status across areas of residence

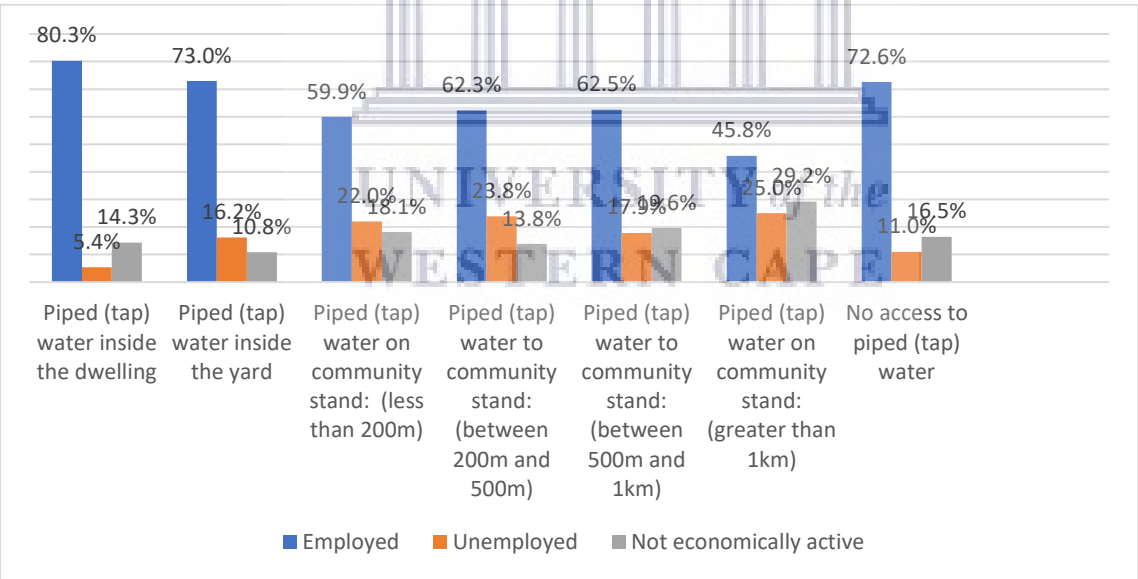
4.7.5.1 Access to piped water by employment status in metropolitan areas

Employment is a crucial variable that determines one's access to scarce resources in everyday life. To test this assumption, the study cross-tabulated the access to piped water and employment status in metropolitan areas. In fact, there are three categories under 'Employment status', namely: Employed, Unemployed, and Not Economically Active. It is evident from the findings that 80% of employed migrants are likely to access piped water inside the dwelling, followed by 5% of unemployed and 4% of not economically active migrants. The findings show that migrants who are employed are dominating the access of water in all categories of piped water in metropolitan areas. This suggests that employed migrants have an advantage

over non-working migrants, as they can afford the water costs. The results show remarkable numbers of unemployed migrants accessing water in community stands from distances of between 200m-500m and 1km and above: 23.8% and 25% respectively. This indicates that high numbers of unemployed migrants in metropolitan areas are likely to access piped water at remarkable distances away from their houses.

A Chi-square test was used to test the relationship between access to piped water in metropolitan areas and migrants' employment status. The data show a p-value of 0.000, which is far less than the standard value of 0.05. This, therefore, means that there is a significant relationship between access to piped water and migrants' employment status. In other words, this means that migrants' access to piped water inside their dwellings is determined by their employment status. To measure the strength of association between the variables, the study used Lambda, Phi and Cramer's V. The findings show that there is a very weak (0.000) association in metropolitan areas between piped water and employment.

Fig. 4.3.7 Distribution of piped water by employment status in metropolitan regions



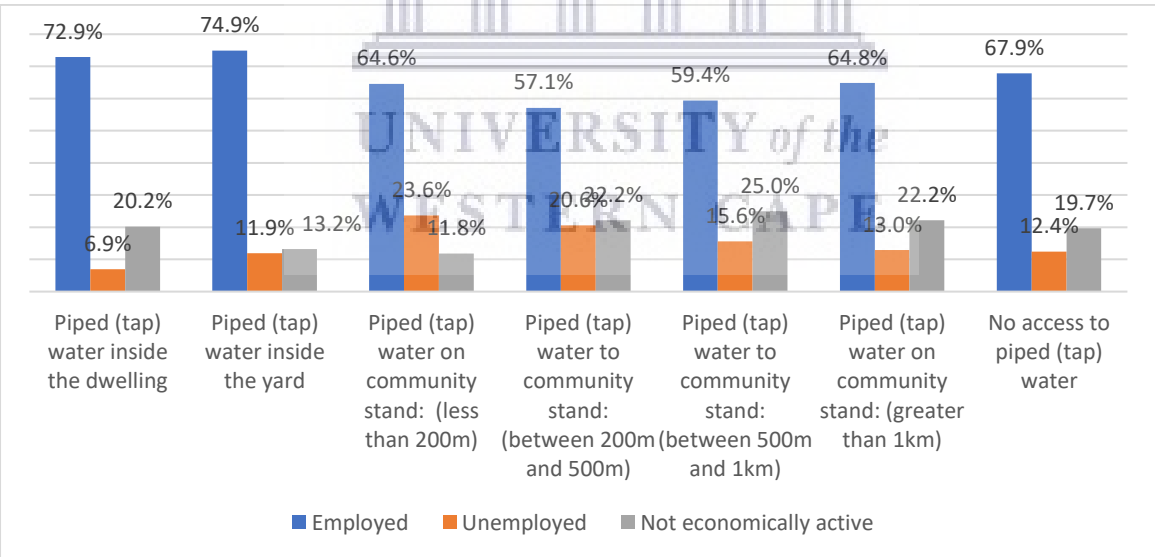
4.7.5.2 Access to piped water by employment status in non-metropolitan areas

The findings in Fig. 4.3.8 below show the differences in access to piped water in non-metropolitan areas in respect of migrants' employment status. The results show that 73% of employed migrants living in non-metropolitan areas are likely to access piped water inside the dwelling, followed by 20% of those who are not economically active. The data indicate only

7% of unemployed migrants have access to piped water inside the dwelling. The findings show dramatically different rates of access to piped water inside the yard. Unemployed migrants had almost the same percentages (12%) as non-economically active migrants (13%). This suggests that unemployed and non-economically active migrants have equal chances of accessing piped water inside their yards while employed migrants have fair access with 75%. With regards to no access to piped water, the findings show that non-economically active migrants are more likely not to have access to piped water than those who are willing to get a job but are unemployed (19.7% and 12.4% respectively).

To assess the association between 'access to piped water' and 'employment status' in non-metropolitan areas, the study used a Chi-square statistical test. The findings showed a p-value of 0.000, which is less than the value of 0.05. This means that there is a relationship between access to piped water and employment status in non-metropolitan areas. The study used Lambda, Phi and Cramer's V to measure the strength of the association between the above variables. The findings show a weak association (0.000).

Fig. 4.3.8 Distribution of piped water by employment status in non-metropolitan regions

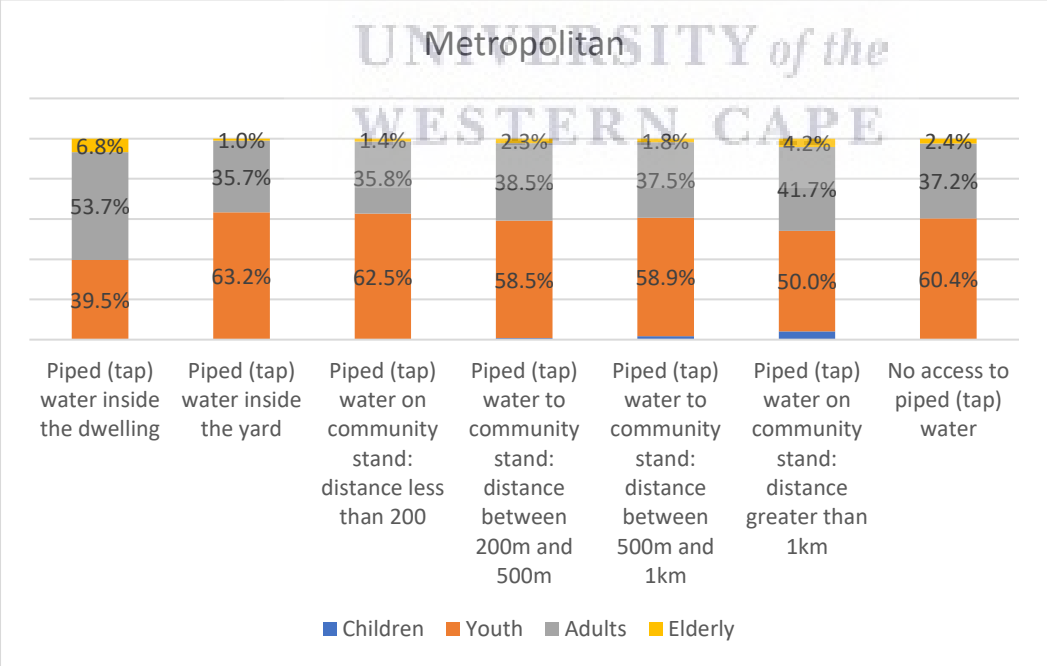


4.7.6 Piped water by age groups across areas of residence

4.7.6.1 Access to piped water by age group in metropolitan areas

Figure 4.3.9 below shows the distribution of migrants' access to piped water with regards to their age group. The results show the association in access to water and age. When looking at the piped water inside the dwelling, the results show that adult (36-60 years) and youth (15-35 years) migrants have higher chances of accessing piped water inside their dwelling, with 53.7% and 39.5% respectively. Elderly and children migrants have a small proportion, with 6.8% and 0.1% respectively. The results show low percentage when it comes to children and elderly migrants. This is because these people at this age tend to be dependents, hence it is not they who are responsible for the access of water, but the heads of their households. The study has made use of a Chi-square statistical test to measure the association between access to piped water in metropolitan areas and age group. The results showed a p-value of 0.000. Since the p-value of 0.000 is less than the cut-off value of 0.05, we can conclude that there is a statistically significant relationship between access to piped water and age group. Lambda, Phi and Cramer's V were used to measure the strength of the relationship between piped water and age group in metropolitan areas. The findings show a very weak association (0.000).

Fig. 4.3.9 Distribution of piped water by age group in metropolitan regions

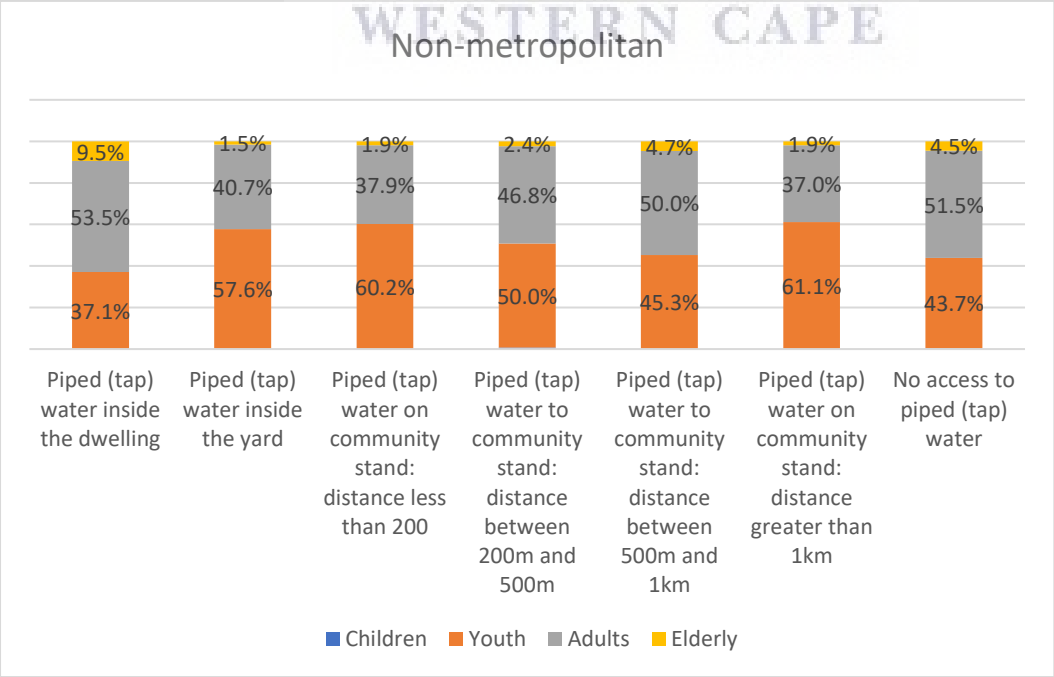


4.7.6.2 Access to piped water by age group in non-metropolitan areas

Figure 4.3.10 below shows the results of the questions about access to piped water in non-metropolitan areas and age group. The cross-tabulation was performed to examine the relationship between the two variables and to see on what age group the migrants are most likely to access piped water. The results show that youth and adult migrants are more likely to access piped water from inside and outside the dwelling than children and elderly migrants. However, the findings indicate a remarkable proportion of elderly (65+ years) migrants having access to piped water inside their dwellings. This is because migrants over 65 years are too old to fetch water, so they simply have piped water inside the dwelling.

To examine the relationship, the study has used Chi-square statistics and the results showed a p-value of 0.000 and conclude that there is a statistically significant relationship between access to piped water and age group in non-metropolitan areas. The findings depict that youth migrants are most likely to access piped water in sources outside the dwelling followed by adult migrants, children and elderly migrants. To measure the strength of association between the variables, the study used Lambda, Phi and Cramer's V. The findings show no or a very weak association (0.000).

Fig. 4.3.10 Distribution of piped water by age-group in non-metropolitan regions



4.7.7 Piped water by duration of stay across areas of residence

4.7.7.1 Access to piped water by duration of residence in metropolitan areas

Duration of residence is one of the crucial components in migration studies to give an insight as to how long a migrant stayed in that particular area and how it influenced access to scarce resources. The longer a migrant stay in a place, the more they become familiar and make connections with the environment (Nsengiyumva, 2013). Looking at the metropolitan areas, Table 4.1.1 illustrates the relationship between access to piped water and duration of residence of the migrant. The results show that there has been an increase in access to piped water over the years from 2001 to 2011 in all categories. Looking at access to piped water inside the dwelling, the results show that in 2001-2004 it was only 16.7% of migrants who had access, but this increased to 50.7% in 2009-2011.

Furthermore, Pearson Chi-square test showed a statistically significant relationship between access to piped water and duration of residence in metropolitan areas with $p=0.000<0.05$. This implies that migrants' duration of residence in an area may increase the access to piped water in metropolitan areas. To measure the strength of association between access to piped water and duration of residence, the study used lambda, Phi and Cramer's V. Lambda showed a strong (0.827) association between the variables. Phi and Cramer's V showed no association (0.000) between the variables.

4.7.7.2 Access to piped water by duration of residence in non-metropolitan areas

Duration of residence is another important factor influencing access to piped water. Table 4.1.1 below also displays the distribution between access to piped water in non-metropolitan areas and the duration of residence between 2001-2004; 2005-2008; and 2009-2011. Looking at the period of 2001-2004, the data reveal that migrants were most likely to access piped water in community stands at a distance greater than a kilometre (16.7%), followed by those having access inside the dwellings and those with no access at all to piped water (15.3% and 11.5% respectively). The results show an increase in access by each period.

The result from hypothesis testing indicates that the Chi-square test statistics was statistically significant with a p-value of 0.000, which is less than a standard value of 0.05. Therefore, there is a relationship between duration of residence and access to water. To the measure the strength

of association between the variables, the study used Lambda, Phi and Cramer's V. The findings show that there is a very weak association (0.000) between the variables.

Table 4.4.1 Distribution of piped water by duration of residence in metropolitan and non-metropolitan areas

METROPOLITAN AREAS							
Duration of residence	**Piped water inside the dwelling**	**Piped (water inside the yard**	**Piped (tap) water on community stand (less than 200m)**	**Piped water to community stand (between 200m and 500m)**	**Piped (tap) water to community stand (between 500m and 1km)**	**Piped water on community stand (greater than 1km)**	**No access to piped water**
2001-2004	16.7%	14.4%	18.9%	23.8%	16.1%	12.5%	14.0%
2005-2008	32.5%	27.1%	34.1%	35.4%	35.7%	45.8%	25.0%
2009-2011	50.7%	58.5%	47.0%	40.8%	48.2%	41.7%	61.0%
NON-METROPOLITAN AREAS							
2001-2004	15.3%	9.6%	9.6%	7.1%	7.8%	16.7%	11.5%
2005-2008	30.9%	22.3%	24.5%	25.4%	25.0%	22.2%	27.3%
2009-2011	53.8%	68.1%	65.9%	67.5%	67.2%	61.1%	61.1%

***Source**:* 10% of the 2011 Census data

4.8 Water sources across metropolitan municipalities

Table 4.5 below shows the findings of accessing drinkable water across the metropolitan regions of the country. Looking at the regional/local water schemes, the findings show that the City of Johannesburg, City of Tshwane, and City of Cape Town are the metropolitan regions that distribute the most water in regional water schemes, with 36.3%, 20.0%, and 17.5% respectively. Nelson Mandela Bay, Buffalo City, and Mangaung have the least of 1.5%, 1.6%, and 1.7% respectively. This indicates that the distribution of basic services by local authorities differ from one metropolitan area to the other. Big cities like Johannesburg and Cape Town are bloated by vast numbers of people because of the public facilities distributed in these areas, attracting many people from other areas. The results show that metropolitan municipalities located in predominantly rural areas, such as Buffalo City, distribute their water mostly from rivers and streams.

The Chi-square test statistic was used to examine the relationship between access to water sources and migrants' level of education in metropolitan areas. The findings show a p-value of 0.000, which is less than the standard value of 0.05. Since the p-value is less than the value of 0.05 we have enough statistical evidence that there is a significant relationship between water sources and migrants' level of education in metropolitan areas. This implies that migrants' level of education can determine the chances of having access to water sources in metropolitan areas. To measure the strength of association between these two variables, the study used Lambda, Phi and Cramer's V. Lambda test shows a strong association (0.658), while Phi and Cramer's V show no association (0.000).

Table 4.5 Distribution of water sources among migrants across metropolitan areas (%)

	City of Cape Town	Buffalo City	Nelson Mandela Bay	Mangaung	eThekwini Metropolitan	Ekurhuleni	City of Johannesburg	City of Tshwane	**Total**
Local/regional water scheme	17.50	1.60	1.50	1.70	8.50	12.90	36.30	20.00	100
Borehole	5.90	1.20	0.40	2.30	5.10	14.50	34.40	36.30	100
Spring	0.00	0.00	0.00	6.70	20.00	13.30	33.30	26.70	100
Rain-water tank	3.10	6.30	0.00	0.00	9.40	12.50	43.80	25.0	100
Dam/pool/stagnant water	13.50	2.60	0.00	0.00	18.40	10.50	47.40	7.90	100
River/Stream	14.30	28.60	14.30	0.00	14.30	0.00	14.30	14.30	100
Water vendor	13.30	0.00	2.00	1.00	13.30	8.20	50.00	12.20	100
Water tanker	9.90	1.00	1.00	2.00	16.80	4.00	38.60	26.70	100
Other	14.00	3.70	1.40	1.40	7.90	9.80	34.00	27.90	100
Total	117.10	1.70	1.50	1.70	8.50	12.80	36.40	20.40	100

Source: 10% of the 2011 Census data

4.8 Demographic and socioeconomic characteristics of migrants and water sources

This section examines the relationship between access to water sources and demographic aspects such as migrants' population group, level of income, employment status, and level of education, just to name a few.

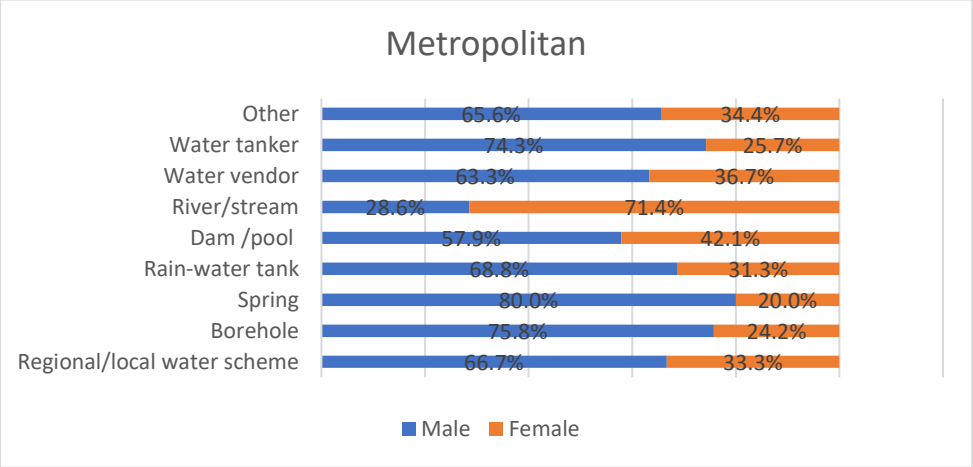
4.8.1 Water sources by gender across areas of residence

4.8.1.1 Water sources by gender in metropolitan areas

The study has cross-tabulated water sources and gender to examine the variation and relationship between the two variables in metropolitan regions. The findings show that 67% of male migrants access water from local water schemes provided by the local government, while only 33% of their female counterparts do. This implies that there is bias in service delivery based on gender, males being more privileged and having more access to water sources than females. Regardless of the fact that females are the primary users of domestic water, the findings show remarkable numbers of female migrants having access to water from open space water sources, 42.1% of them accessing water from stagnant water sources and 71.4% in rivers or streams, while 58% and 29% respectively of male migrants do the same.

To examine the relationship between migrants' gender and water sources in metropolitan areas, the study used the Chi-square test statistic. The findings show a p-value of 0.011, which is less than the standard value of 0.05. This shows that there is a significant relationship between migrants' gender and access to water sources in metropolitan areas. To measure the strength of the association between water sources and migrants' gender in metropolitan areas, the study used Lambda, Phi and Cramer's V. The findings show no relationship (0.000) between the variables in metropolitan areas.

Fig. 4.4 Distribution of water sources by gender in metropolitan areas

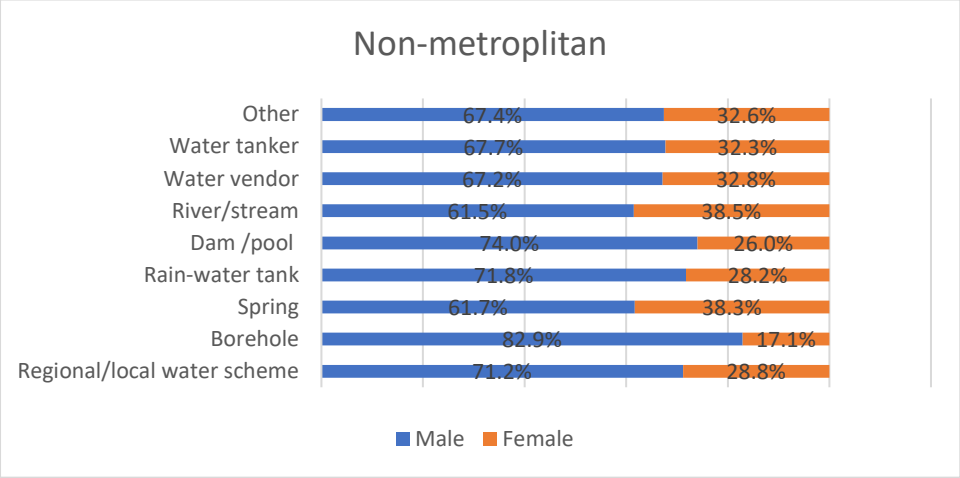


4.8.1.2 Water sources by gender in non-metropolitan areas

Figure 4.4.1 below shows that male migrants in non-metropolitan areas are most likely to access water in regional water scheme (71%), while female migrants account for 29%. The percentage further increased for male access to borehole water and accounted for 83%, while female migrants decreased and accounted for 17%. This might be influenced by the difference in economic status between the two genders, males having more chances of affording the costs of borehole installations than female-headed households. The results show the considerable increase in female access to other sources, such as springs (38%) and rivers/streams (39%).

To assess the association between migrants' gender and access to water sources in non-metropolitan areas, the study has used Chi-square test statistic. The findings suggest that there is a significant relation between these two variables as the p-value is 0.000, which is less than the standard value of 0.05. Therefore, this means that gender plays a huge role in determining migrants' access to water sources in non-metropolitan areas. The strength of the association was measured using Lambda, Phi and Cramer's V. Lambda test showed no association (0.00), whereas Phi and Cramer's V show a strong association (0.975).

Fig. 4.4.1 Distribution of water sources by gender in non-metropolitan areas



4.8.2 Water sources by population groups across areas of residence

4.8.2.1 Water sources by population groups in metropolitan areas

Table 4.5.1 below depicts the findings on water sources and population groups in both metropolitan and non-metropolitan areas. In metropolitan regions, Black and White migrants have more access to drinkable water in water sources than Coloured and Indian/Asian migrants. In regional or local water scheme, 46% of Black migrants had access and 42.9% of White migrants, while Coloured and Indian/Asian migrants were just 4.9% and 6.4% respectively. The results show that Coloured migrants are less likely to obtain water from springs, river/streams, and water vendors as they all showed 0.0% of usage. In as much as the Indian/Asian population is small, there are noticeable proportions of their usage regarding water sources. They are most likely to use spring water (6.7%), followed by the regional/local water schemes (6.4%) and water tankers (5.9%).

To assess the relationship between water sources and migrants' population group, the study used a Chi-square test statistic as a tool. The findings show a p-value of 0.000, which is less than the standard value of 0.05. Therefore, we have a statistical evidence that there is a significant relationship between water sources and population group in metropolitan areas. This suggests that access to water sources in metropolitan areas could be influenced by population group of the migrant. The study used Lambda, Phi and Cramer's V to measure the strength of association between water sources and migrants' population group in metropolitan areas. All the findings show a weak association (0.000) between the variables.

4.8.2.2 Water sources by population groups in non-metropolitan areas

Looking at the situation in non-metropolitan areas, the findings reveal that Black migrants are most likely to access water from water vendors (88.1%), water tanker (88.0%), stagnant water (78.8%), and rivers/streams (77.9%). This gives an indication that migrants in non-metropolitan areas are most likely to use vulnerable and open water sources; if not, they buy their water from water-vendors. This means that water access to safe water sources is a considerable issue for Black migrants. However, there is a difference when it comes to White migrants, as the majority is most likely to access water from boreholes (41.6%), regional water schemes provided by the local government (39.6%), and the use of springs (36.7%). In contrast, the findings represent small proportions for Coloured and Indian/Asian migrants. This might be because they do not have the means to access boreholes, or because they do not stay near spring water.

The Chi-square test statistic was used to test the association between water sources and migrants' population group in non-metropolitan areas. The findings show a p-value of 0.000, which is less than a standard value of 0.05. Therefore, this suggests that there is a significant relationship between population group and migrants' access to water sources in non-metropolitan areas. Lambda, Phi and Cramer's V tests were used to measure the strength association between the variables. The findings show no association (0.000).

Table 4.5.1 Distribution of water sources by population groups in areas of residence (%)

	Metropolitan Areas					Non-metropolitan Areas				
	Black/ African	Coloured	Indian/Asian	White	Total	Black/ African	Coloured	Indian/ Asian	White	Total
Regional/ local water scheme	45.7	4.9	6.4	42.9	100	53.5	4.2	2.7	39.6	100
Borehole	57.0	2.7	1.2	39.1	100	54.1	3.1	1.2	41.6	100
Spring	66.7	0.0	6.7	26.7	100	56.7	1.7	5.0	36.7	100
Rain-water tank	68.8	3.1	3.1	25.0	100	76.9	1.3	2.6	19.2	100
Dam/pool/ stagnant water	78.9	2.6	2.6	15.8	100	78.8	4.8	2.9	13.5	100
River/stream	85.7	0.0	0.0	14.3	100	77.9	1.6	3.3	17.2	100
Water vendor	86.7	0.0	1.0	12.2	100	88.1	1.5	1.5	9.0	100
Water tanker	85.1	3.0	5.9	5.9	100	88.0	1.9	2.5	7.6	100
Other	78.1	4.7	4.2	13.0	100	83.3	1.5	1.5	13.6	100
Total	47.1	4.8	6.3	41.8	100	56.8	3.8	2.5	36.8	100

***Source**:* 10% of the 2011 Census data

4.8.3 Water soources by level of education across areas of residence

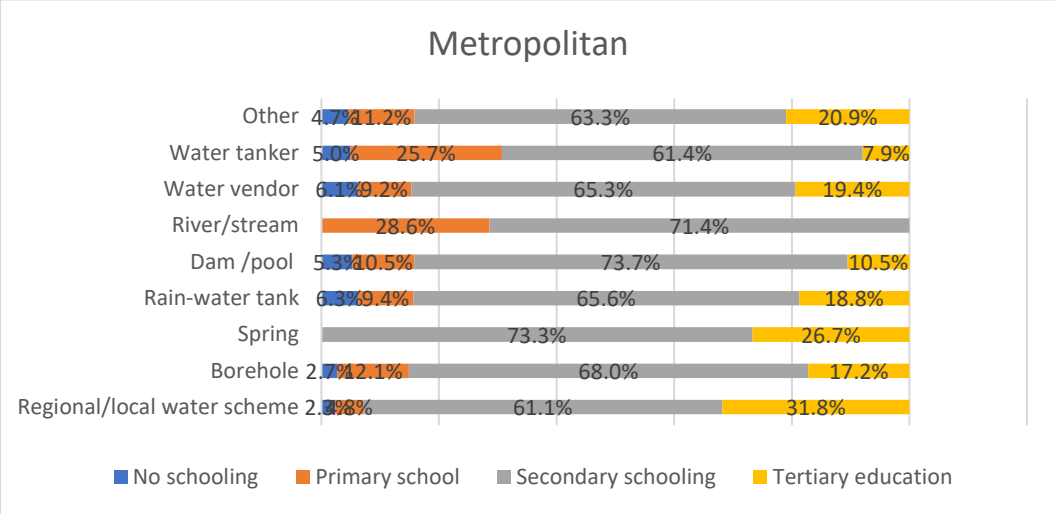
4.8.3.1 Water sources by level of education in metropolitan areas

Higher levels of education are believed to increase awareness of the risks associated with unsafe water sources. It is expected that households headed by migrants with secondary and tertiary education would have comparatively better access to improved and safe drinking water sources than those with little or no formal education.

The results in figure 4.4.2 show that migrants with secondary education have more access to almost every water source, followed by those with tertiary education. Looking at the regional/local water scheme provided by the government, 61% of migrants with secondary education had access to this source, followed by 32% of those with tertiary education. At lower level, migrants with primary school and those with no formal education had the least access of just 5% and 2% respectively. The proportion of migrants with primary schooling and with no education using rain-water tanks increased slightly to 9.4% and 6.3% respectively.

The Chi-square test statistic was used to examine the relationship between access to water sources in non-metropolitan areas and migrants' level of education. The findings indicate a p-value of 0.000 which is less than the standard value of 0.05. Therefore, since the p-value is less than the standard value of 0.05, we have enough statistical evidence that there is a significant relationship between water sources in these areas and migrants' level of education. This suggests that migrants' level of education can determine the chances of having access to water sources in non-metropolitan areas. The strength of association between the variables was measured using Lambda, Phi and Cramer's V. The findings show a very weak association (0.000) between the variables.

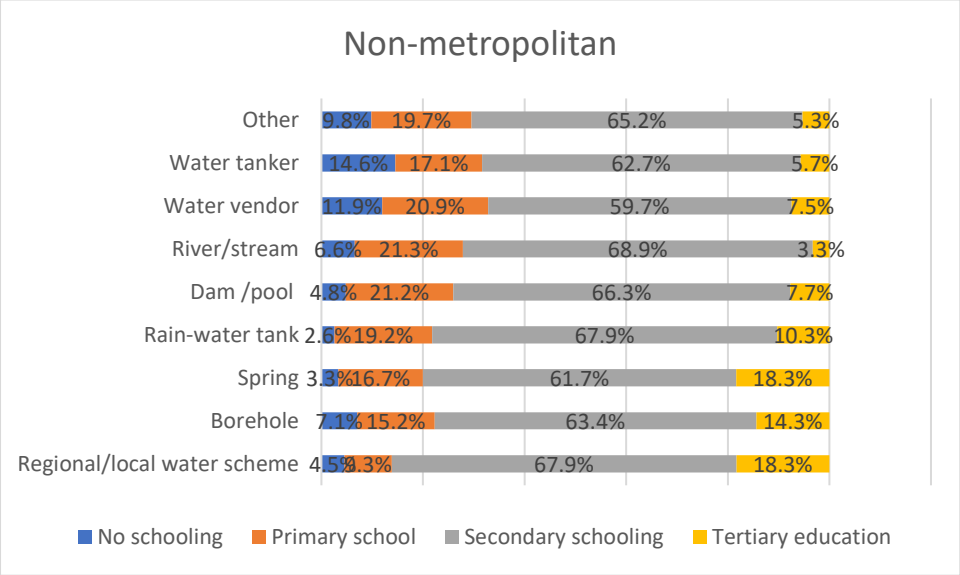
Fig. 4.4.2 Distribution of water sources by level of education in metropolitan areas



4.8.3.2 Water sources by level of education in non-metropolitan areas

The findings indicate that migrants with secondary education also have high percentages in water sources in non-metropolitan areas. 61.1% of migrants with secondary education had access to water in regional water schemes, followed by those with tertiary education with 31.8%. The lowest figures were 4.8% and 2.3% of migrants with primary and with no formal education (respectively). It is also indicated that migrants with secondary education are more likely to buy water from water vendors (60%), followed by migrants with primary education (21%), while migrants with no education scored 12%. Surprisingly, migrants with tertiary education are less likely to buy water from water vendors than any other migrants (8%). This implies that migrants with higher level of education do not prioritise buying water; rather, they use other sources because they have other opportunities and means to diversify water sources. A Chi-square test was used to test the association between access to water sources and migrants' level of education in non-metropolitan areas. The findings confirm a significant relationship between these variables, as the p-value was 0.000. This is because the p-value is less than a standard value of 0.05. This suggests that migrants' level of education can influence the access to water sources in non-metropolitan areas. The study used Lambda, Phi and Cramer's V to measure the strength of association between water sources and level of education in non-metropolitan areas. The findings show a very weak association (0.000) between the variables.

Fig. 4.4.3 Distribution of water sources by level of education in non-metropolitan areas



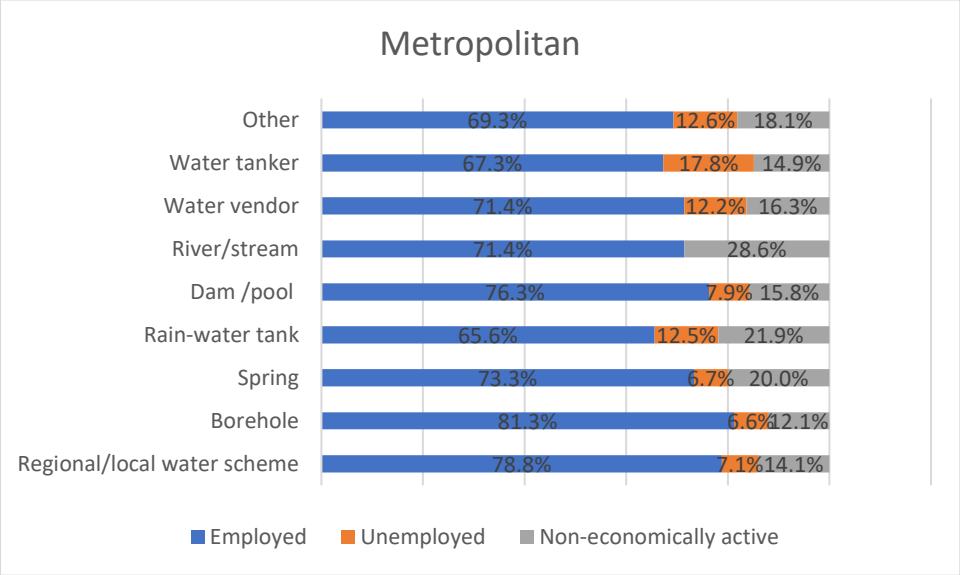
4.8.4 Water sources by employment status across areas of residence

4.8.4.1 Water sources by employment status in metropolitan areas

The study hypothesised that there is a relationship between migrants' access to water sources and employment status. The Census 2011 data classifies household heads as either employed, unemployed, or not economically active. The results in Figure 4.4.4 indicate that employed migrants in metropolitan areas have better access to water sources than unemployed and non-economically active migrants. Considering the access to regional water scheme, 79% of employed migrants had access followed by those who are not economically active and unemployed migrants. This suggests that employed migrants can afford to buy water from water vendors and install boreholes. However, the findings depict remarkable access of unemployed migrants to water tanks (18%). This suggests that unemployed migrants are likely to store water in water tanks.

Furthermore, a Chi-square test was used to examine the relationship between water sources and employment status. The findings depict a p-value of 0.000, which is less than a standard value of 0.05. This suggests that there is a significant relationship between water sources and employment status in metropolitan areas. This implies that employment status determines the possibilities of accessing water sources in metropolitan areas. To measure the strong point of association between water sources and employment status in metropolitan areas, the study used Lambda, Phi and Cramer's V. The findings show a very weak relationship (0.000) between the variables.

Fig. 4.4.4 Distribution of water sources by employment status in metropolitan areas

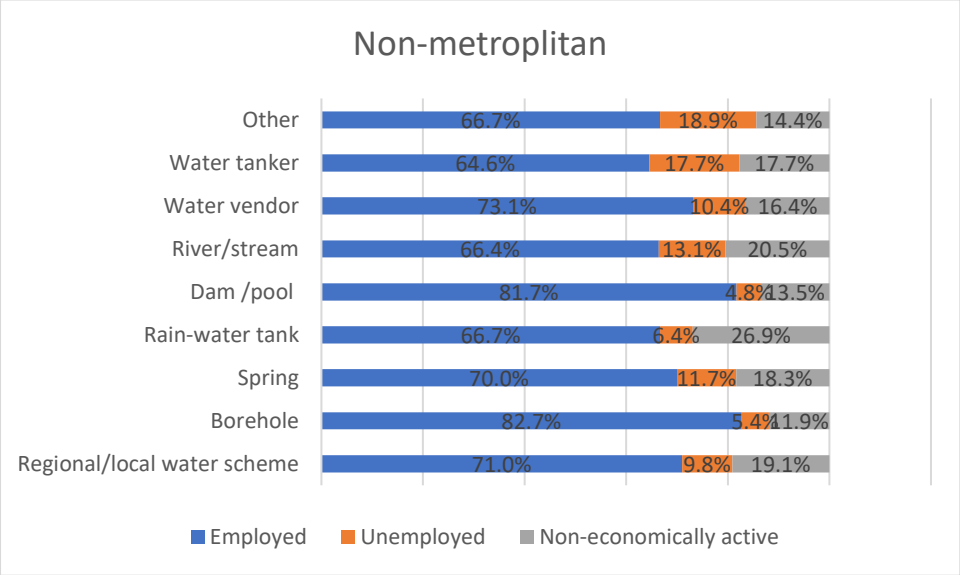


4.8.4.2 Water sources by employment status in non-metropolitan areas

Figure 4.4.5 portrays the findings obtained from cross-tabulating water sources and employment status in non-metropolitan areas. The results reveal that employed migrants in non-metropolitan areas have better access to safe water sources than unemployed and non-economically active migrants. Looking at the regional/local water scheme provided by municipality, employed migrants had high percentages (71%) followed by economically inactive migrants (19%), while unemployed migrants were the least. This suggests that employed migrants can afford to install and have different water sources.

To test the relationship between water sources and migrants' employment status in non-metropolitan areas. The findings from Chi-square test show a p-value of 0.000 which is less than a standard value of 0.05. therefore, it can be concluded that there is a statistic evidence that there is a significant relationship between water sources and employment status in non-metropolitan areas. Lambda, Phi and Cramer's V tests were used to measure the strength of the relationship between water sources and employment status in non-metropolitan areas. The findings show a very weak relationship between the variables, as both tests showed a value of 0.000.

Fig. 4.4.5 Distribution of water sources by employment status in non-metropolitan *areas*



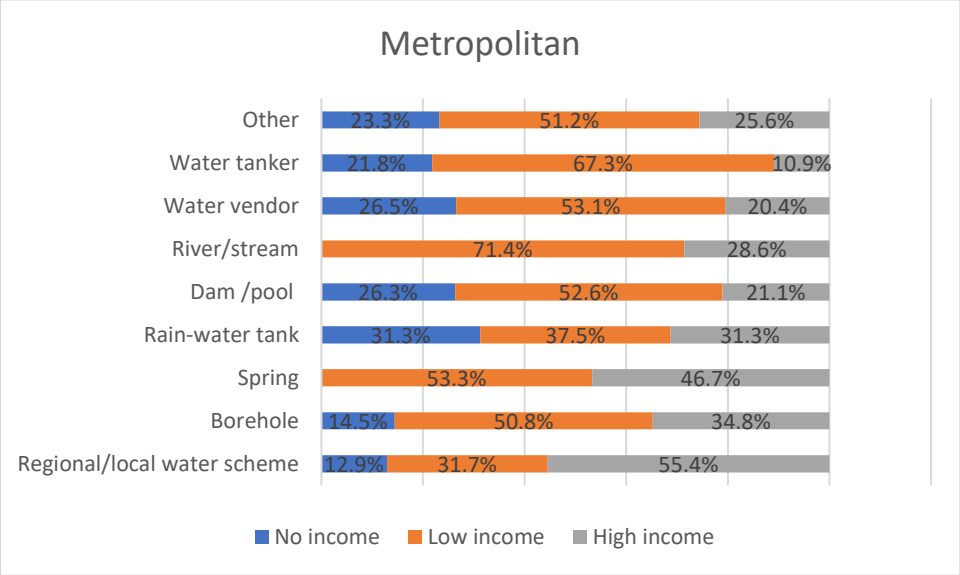
4.8.5 Water sources by level of income across areas of residence

4.8.5.1 Water sources by level of income in metropolitan areas

Poverty is a primary barrier to water access (Ngum, 2011). In the context of this study, this relates to migrants with little or no income. The study hypothesised an association between migrants' level of income and access to water sources. In overall, the findings show that migrants with various levels of income have better access than migrants with no income.

The study has used Chi-square test statistic to measure the relationship between water sources and level of income in metropolitan areas. The findings show a p-value of 0.000, which is less than the standard value of 0.05. Therefore, we have statistical evidence to infer that there is a significant relationship between level of income and water sources in metropolitan areas. This means that migrants' level of income can determine the possibilities of having access to water sources in metropolitan areas. The study used Lambda, Phi and Cramer's V to measure the strength of association between water sources and level of income in metropolitan areas. The findings show very weak or no (0.000) relationship in all the tests.

Fig. 4.4.6 Distribution of water sources by level of income in metropolitan areas



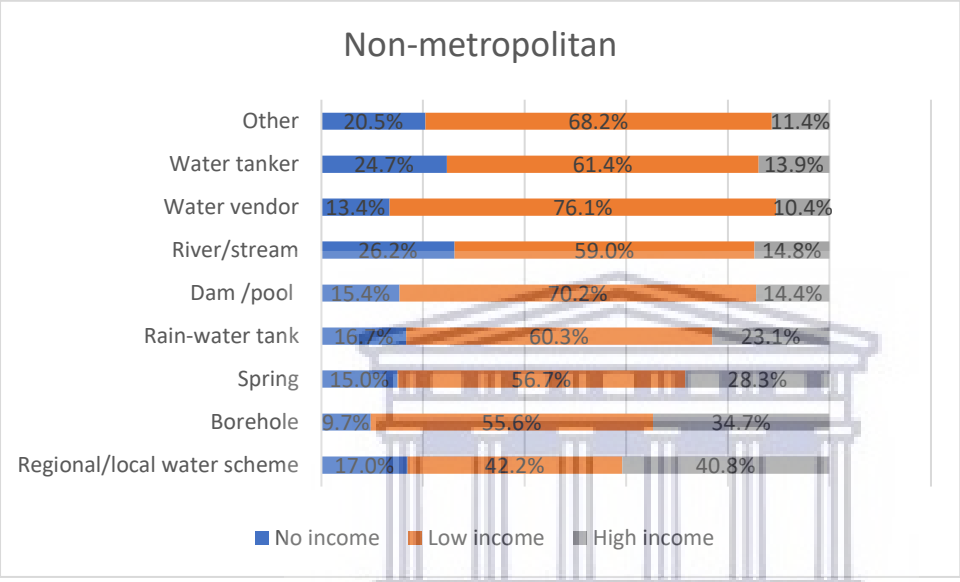
4.8.5.2 Water sources by level of income in non-metropolitan areas

The level of income is also a significant factor in accessing water from water sources in non-metropolitan areas. It is apparent from the findings that migrants with low income in non-metropolitans are more likely to be restricted in their choice of water sources. This may be because people in non-metropolitan areas, particularly in rural areas, are more likely to access their water from unimproved water sources in open spaces. However, the results show that 40.8% of migrants with high levels of income had access to water from regional/local water schemes. Whereas 42.2% of migrants with low income did the same, while just 17% of migrants with no income had access. The results also show notable figures regarding migrants with high income and access to borehole water (35%) and just 10% of migrants with no income. This means that migrants with high income are more likely to access water from boreholes than those with no income, because they can afford the installation and cost of borehole. However, the findings also portray notable percentages (26%) of migrants with no income access water from rivers/streams, while just 15% of migrants with high income do the same. This suggests that migrants with no income are more likely to access water from unimproved water sources or open water sources than migrants with high income who can afford to pay water from improved water sources.

To measure the relationship between water sources and migrants' level of income in non-metropolitan areas, the study used Chi-square test statistics. The findings depict a p-value of 0.000. Since the p-value is less than the standard value of 0.05, we have statistical evidence

that there is a significant relationship between water sources and level of income in non-metropolitan areas. Therefore, this implies that migrants' level of income determines the access to water sources in non-metropolitan areas. To measure the strength of association, the study used Lambda, Phi and Cramer's V. The findings show no association, or a very weak association of 0.000 for all the tests.

Fig. 4.4.7 Distribution of water sources by level of income in non-metropolitan areas



4.8.6 Water sources by age groups across areas of residence

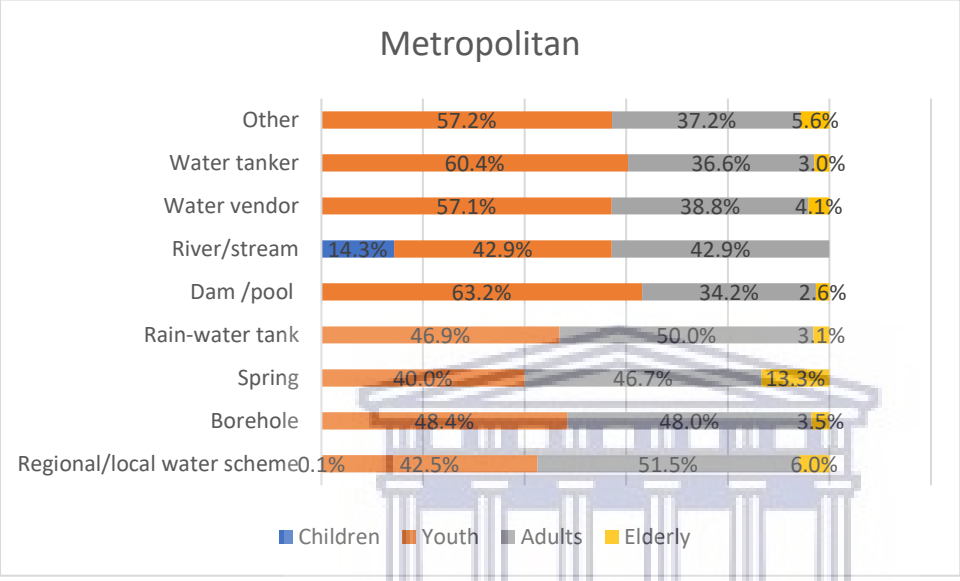
4.8.6.1 Water sources by age group in metropolitan areas

One of the objectives of this study is to determine how access to water varies with age for migrants heading households in their areas of residence. Looking at the regional/ local water scheme operated by the local government, the findings show that 51.5% of adult migrants in metropolitan areas had access to this water source followed by 42.5% of youth migrants. The study also shows a noticeable percentage of elderly migrants having access to spring water followed by youth with 40% and adult migrants with 46.7%, children having no access in this water source.

To test the association between water sources and migrants' age group in metropolitan areas, the findings show a p-value of 0.000, which is less than the standard value of 0.05. This implies that we have enough statistical evidence that there is a significant relationship between water sources and migrants' level of income in metropolitan areas. This implies that level of income

in non-metropolitan areas can determine the access to water sources. Lambda, Phi and Cramer's V were used to measure the strength of the association between water sources and age. The findings show that there is a very weak (0.000) relationship between migrants' access to water sources in metropolitan areas by age.

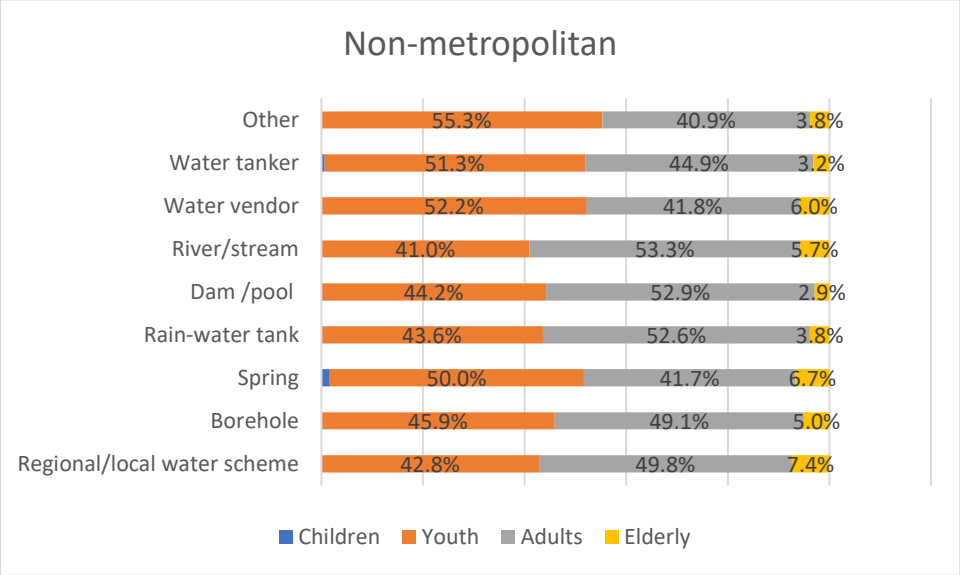
Fig. 4.4.8 Distribution of water sources by age group in metropolitan areas



4.8.6.2 Water sources by age group in non-metropolitan areas

Access to water sources in the non-metropolitan areas by age was also examined. The findings indicate that young and adult migrants have more access to water than elderly people and children. This may be because these groups are not necessarily responsible for matters of the household, including access to water sources. Chi-square test statistic was used to test the relationship between water sources and migrants' level of income in non-metropolitan areas. The findings show a p-value of 0.000, which is less than the standard value of 0.05. Thus, we have a statistical evidence that there is a significant relationship between water sources and migrants' level of income in non-metropolitan areas. This means that migrants' access to water sources may be determined by migrants' level of income. To measure the strength of association between these variables, the study used Lambda, Phi and Cramer's V. Lambda test shows a moderate association (0.040). Phi and Cramers' V show a very weak or no (0.000) relationship between the variables.

Fig. 4.4.9 Distribution of water sources and age group in non-metropolitan areas



4.8.7 Water sources by duration of stay across areas of residence

4.8.7.1 Water sources by duration of stay in metropolitan areas

The number of years migrants stay in a particular area is important as it can increase the likelihood of access to water sources in that area. Looking at the duration of stay between 2001-2004, the findings show that migrants were most likely to use water from rainwater tanks (21.9%), followed by those using water from springs and stagnant water (20.0% and 18.4% respectively). Considering the year from 2005 to 2008, there was a slight change in the pattern of water sources being used. A large number of migrants utilised water from springs (46.7%), followed by those using rainwater tanks (37.5%) and boreholes (34.8). Between 2009-2011, many settlers used other types of water sources not depicted in the data (58.1%), followed by those buying water from water vendors (57.1%), and stagnant water such as those from pools and dams (55.3%).

A Pearson Chi-square test was used to measure for association between water sources and duration of residence. The results show a p-value of 0.661 which is greater than a standard value of 0.05. This means statistically there is no significant relationship between water sources and the duration of residence. In other words, the duration of residence does not determine which water source a migrant is likely to use in metropolitan areas.

4.8.7.1 Water sources by duration of stay in non-metropolitan areas

The distribution of water sources and the duration of residence in non-metropolitan areas is also illustrated in Table 4.5.2. The distribution shows that during 2001-2004 the majority of settlers bought their water from the water vendors (14.9%), followed by those who accessed their water from the regional water schemes (13.8%) and rainwater tank (12.8%). Looking at the year from 2005-2008, the results show that migrants were most likely to use other sources (30.5%), which was followed by 29.8% of those using stagnant water as their water source, and 28.6% of those using regional/local water schemes. From 2009 to 2011, the migrants in non-metropolitan areas were most likely to access water from the rivers/streams (70.5%) followed by those using water from springs (66.7%), and boreholes (61.5%).

The findings from Chi-square test statistic reveal that there is no relationship between water sources and the duration of residence in non-metropolitan areas. This is because the findings showed a p-value of 0.409, which is greater than the standard value of 0.05. This means that migrants do not need to stay in an area for a specific time to access water from a particular source of water. In other words, the source of water is independent of the duration of time migrants stay in a place.

Table 4.5.2 Distribution of water sources and duration of residence in metropolitan and non-metropolitan areas

METROPOLITAN									
Duration of residence	Regional/ local water scheme	Borehole	Spring	Rain-water tank	Dam/pool/ stagnant water	River/stream	Water vendor	Water tanker	Other
2001-2004	16,6%	15,6%	20.0%	21,9%	18,4%	-	13,3%	16,8%	15,8%
2005-2008	32,1%	34,8%	46,7%	37,5%	26,3%	-	29,6%	30,7%	26,0%
2009-2011	51,3%	49,6%	33,3%	40,6%	55,3%	-	57,1%	52,5%	58,1%
NON-METROPOLITAN									
2001-2004	13,8%	11,1%	11,7%	12,8%	11,5%	7,4%	14,9%	12,0%	12,1%
2005-2008	28,6%	27,5%	21,7%	28,2%	29,8%	22,1%	23,9%	26,6%	30,3%
2009-2011	57,6%	61,5%	66,7%	59,0%	58,7%	70,5%	61,2%	61,4%	57,6%

Source: 10% of the 2011 Census data

4.9 Socio-demographic and socio-economic characteristics of migrant and access to alternative water sources

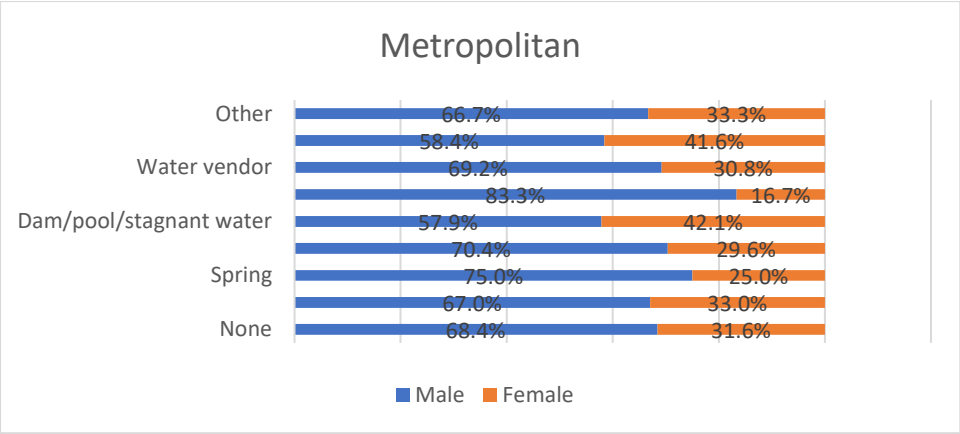
In Census 2011, migrants were also asked about their alternative sources of water they were using. The results showed variations in access to alternative water sources in metropolitan and non-metropolitan areas in respect of migrants' demographic and socio-economic characteristics.

4.9.1 Access to alternative water sources by gender across areas of residence

4.9.1.1 Alternative water sources by gender in metropolitan areas

This study hypothesised that there is an association between access to alternative water sources and gender across migrants in areas of residence. By looking at the results on gender and access to alternative water sources in Figure 4.5, households headed by male migrants have more access to alternative water sources than their female counterparts. Despite the notion that females are the main users of water, the findings indicate that they have limited access to alternative sources compared to males. However, the results show remarkable numbers of females using stagnant water, such as dams, and water tanks (42.1% and 41.6% respectively). The study has used a Chi-square statistical test to investigate the relationship between access to alternative water sources and gender difference in metropolitan areas. The findings show a p-value of 0.58. Since the p-value is greater than the value of 0.05, the results show no relationship between the two variables.

Fig. 4.5 Distribution of alternative water sources by gender in metropolitan areas

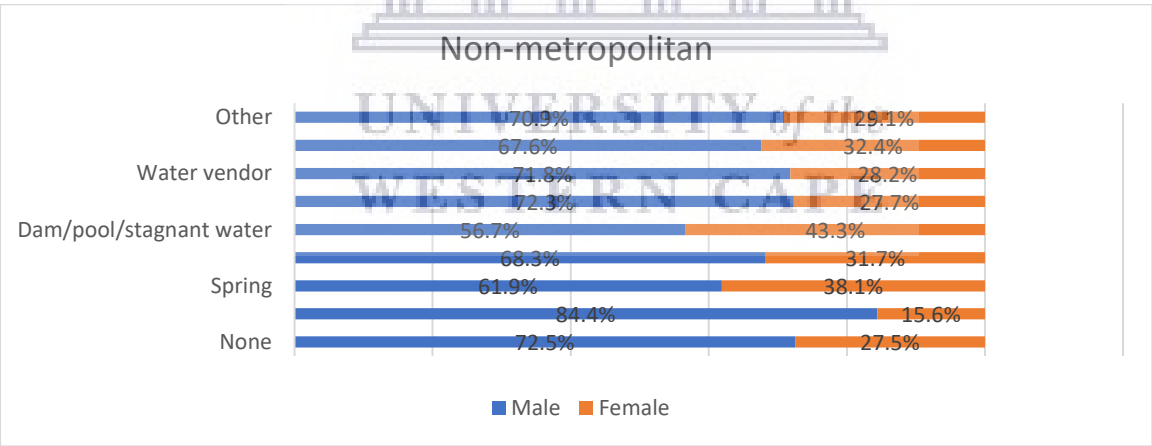


4.9.1.2 Alternative water sources by gender in non-metropolitan areas

Findings in figure 4.5.1 below show access of water from alternative water sources based on gender differences in non-metropolitan areas. Looking at migrants with no alternative water sources, the results show 73% of male migrants with no alternative water sources and 28% of females in non-metropolitan regions. By looking at the rest of the alternative sources, the figures imply that male migrants are the ones likely to have more alternative water sources than female migrants. Boreholes were an alternative source, with 84% of male migrants using them and just 16% of female migrants chose them as their alternative.

Chi-square test statistics was used to examine the association between alternative water sources in non-metropolitan areas and gender difference. The results revealed a p-value of 0.046 between the two variables. Thus, there is a significant relationship between access to alternative water and gender. The study used Lambda, Phi and Cramer's V to measure the strength and weakness of the association between alternative water sources and gender in non-metropolitan areas. The findings from Lambda indicate no association (0.00), whereas Phi and Cramer's V show a very weak association (0.046).

Fig. 4.5.1 Distribution of alternative water sources by gender in non-metropolitan areas



4.9.2 Access to alternative water sources by population groups in areas of residence

4.9.2.1 Alternative water sources by population group in metropolitan areas

Table 4.6 below displays the findings on access to water in metropolitan and non-metropolitan regions from alternative water sources by population groups. The white population appears to be the group that was most likely to have alternative water sources (47%), followed by the Black population with 46%. Concerning boreholes, 74% of the Black population used it as an

alternative water source followed by 21% of white population, 5% of Coloured and just 1% of Indian/Asian. This suggests that in metropolitan areas the African and white populations are more likely to use boreholes as an alternative water source than Coloured and Indian/Asian population. The findings show that 100% of the African/Black population was using river/stream water as their alternative water source, with 0% of the Coloured, Indian/Asian, and white population groups doing so. This implies that water from river/stream sources are more likely to be used by the Black population as alternative sources than any other population group.

To examine the relationship between alternative water sources and population groups, the study performed the Chi-square statistical test to show the association between these two variables. The findings showed a p-value of 0.000, which is less than the standard value of 0.05. Therefore, since the p-value is less than the standard value of 0.05, we have evidence that there is a significant relationship between alternative water sources and migrants' ethnic groups. This means that in metropolitan areas having alternative water sources can vary across migrants' population groups. To measure the strength of the relationship between alternative water sources and population group in metropolitan areas, the study used Lambda, Phi and Cramer's V. The findings from Lambda (0.004) show a very weak association, while Phi and Cramer's V (0.000) show no association.

4.9.2.2 Alternative water sources by population groups in non-metropolitan areas

Table 4.6 below also portrays results on access to water in non-metropolitan areas from alternative water sources and population group. The results indicate that White and Black migrants have better access to alternative water sources in metropolitan areas. When looking at Black migrants, the findings show that they are more likely to use spring water (83.3%) as the alternative source. Whites are more likely to use rainwater tanks (34.9%). The results show that Coloured migrants are less likely to use water from boreholes (0%) as their alternative water source, while Indian/Asian migrants, on the other hand, are less likely to use stagnant water (0%).

Further statistical analysis was performed to test the association between alternative water sources and population group, and the study found a p-value of 0.05. This means that there is a significant relationship between the two variables. To measure the strength of the relationship

between alternative water sources and gender, the study used Lambda, Phi and Cramer's V. The findings show no association (0.000) between the variables.

Table 4.6 Distribution of alternative water sources by population groups in metropolitan and non-metropolitan regions

	Metropolitan				Non-metropolitan			
	Black/African	Coloured	Indian/Asian	White	Black/African	Coloured	Indian/Asian	White
None	45.5%	2.2%	5.3%	47.1%	51.1%	2.7%	2.2%	44.0%
Borehole	73.9%	4.5%	1.1%	20.5%	72.5%	0.0%	3.7%	23.9%
Spring	58.3%	0.00%	0.00%	41.7%	83.3%	2.4%	4.8%	9.5%
Rainwater tank	63.0%	0.00%	3.7%	33.3%	58.7%	6.3%	0.0%	34.9%
Dam/pool/stagnant	21.1%	10.5%	5.3%	63.2%	66.7%	3.3%	0.0%	30.0%

***Source**:* 10% of the 2011 Census data

4.9.3 Access to alternative water sources by level of education across areras of residence

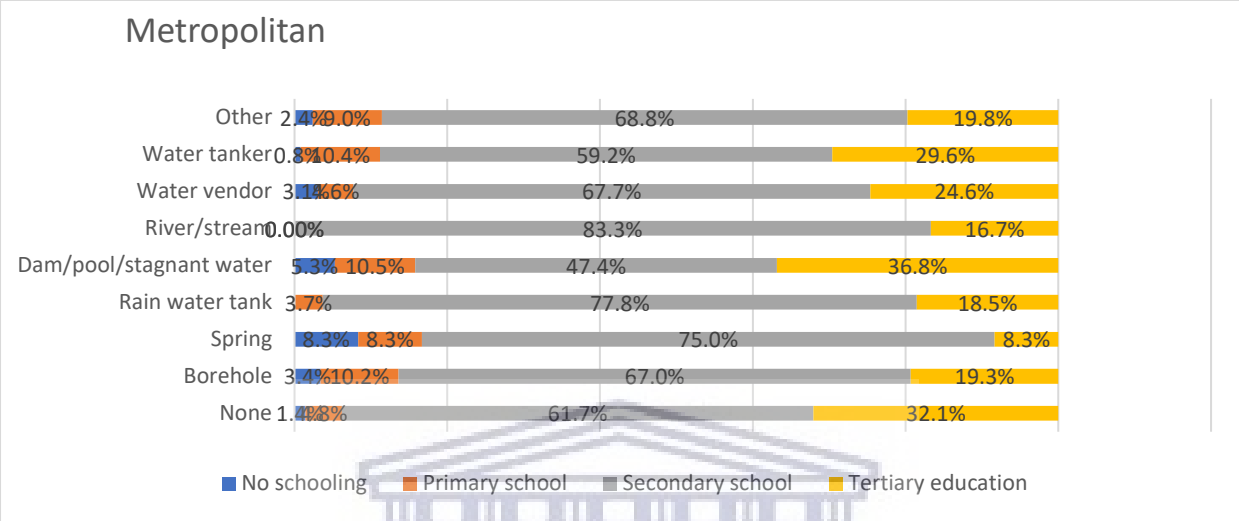
4.9.3.1 Alternative water sources by level of education in metropolitan areas

One of the objectives of this study is to determine whether level of education influences the use of certain alternative water sources. Looking at Figure 4.5.2, the results show that migrants with secondary and tertiary education have more options to alternative water sources than those with primary or no schooling. It is apparent from the findings that most migrants with alternative water sources are migrants with at least secondary schooling, followed by those with tertiary education. The findings show that migrants with no formal education and those with primary school are less likely (0%) to use river/stream water as the alternative water source, while migrants with secondary and tertiary education are most likely to use it, with results of 83% and 17% respectively. This is surprising, as it would be expected that migrants with primary or no education are the ones using water from streams, as opposed to most educated migrants.

The study has used Chi-square statistics to test the association between alternative water sources and level of education of migrants in metropolitan areas. The outcome showed a p-value of 0.027, which is less than the standard value of 0.05. This means that there is a significant relationship between alternative water sources and migrants' level of education. Lambda, Phi and Cramer's V were used to measure the strength of the association between alternative water sources and level of education in metropolitan areas. The findings show a

very weak association between the variables, Lambda being 0.001, Phi and Cramer's V with a significance of 0.027.

Fig. 4.5.2 Distribution of alternative water sources by level of education in metropolitan areas

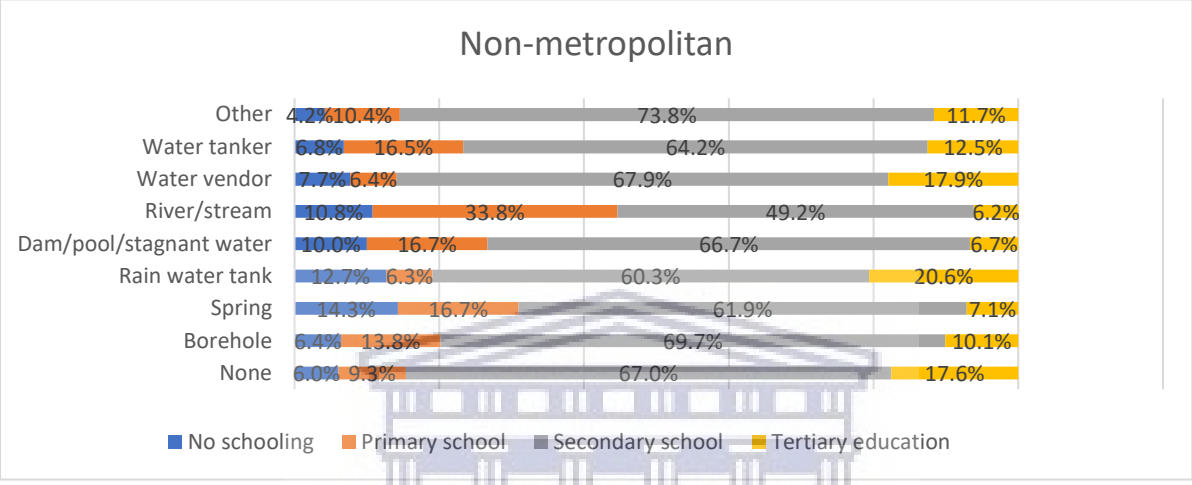


4.9.3.2 Alternative water sources by level of education in non-metropolitan areas

The study has cross-tabulated alternative water sources and migrants' level of education in non-metropolitan areas to examine the relationship between the two variables. The findings show that 70% of migrants with secondary education use boreholes as the alternate water source, followed by 14% of migrants with primary school, 10% of those with tertiary education, and just 6% of migrants with no formal education. Looking at rainwater tanks, the findings demonstrate notable figures of migrants with tertiary education and those with no schooling with 21% and 13% respectively, and just 6% of the ones with primary education. Looking at accessing water from the water vendors, 18% of migrants with tertiary education are buying water from water vendors as their alternative water sources, 8% are those with no formal education, and just 6% of those are migrants with primary schooling. This implies that migrants with higher education are more likely to buy water than those with primary and no schooling as they may be able to afford it, or perhaps they buy water for drinking only.

A Chi-square statistical test was performed to examine the association in non-metropolitan areas between alternative water sources and level of education. The findings showed a p-value of 0,098>0,05, meaning that there is no significant relationship between alternative water sources and level of education of migrants living in non-metropolitan areas.

Fig. 4.5.3 Distribution of alternative water sources by level of education in non-metropolitan areas



4.9.4 Access to alternative water sources by employment status across areas of residence

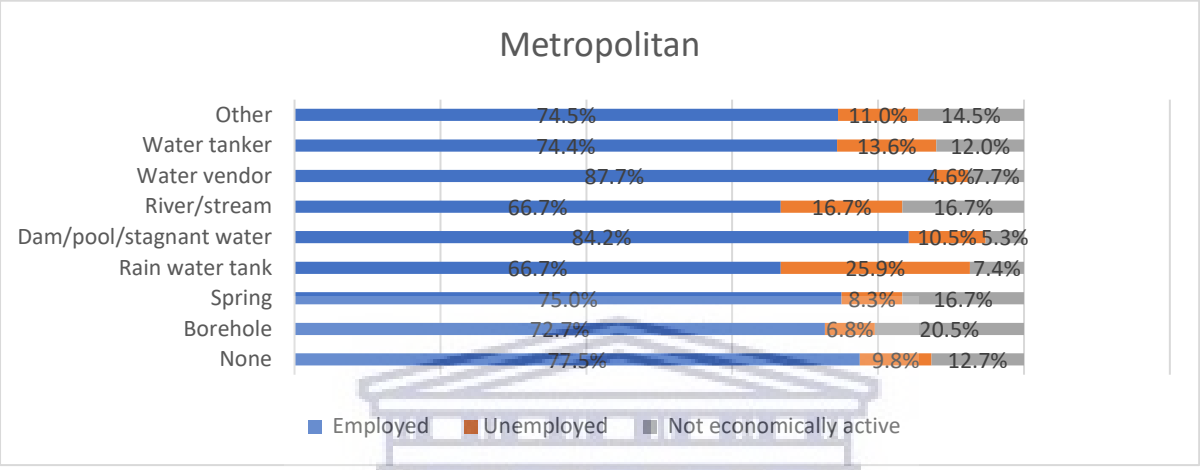
4.9.4.1 Alternative water sources by employment status in metropolitan areas

The study examines how employment status contributes to migrants' use of alternative water sources in metropolitan areas. Overall, employed migrants have better access to alternative water sources than unemployed and non-economically active migrants. This is because these migrants can afford other alternatives, such as purchasing water from vendors, installing boreholes, and water tanks. Nonetheless, the findings show a remarkable 26% of unemployed migrants using rainwater tanks. This suggests that migrants who cannot afford piped water are more likely to use natural water sources as their alternative water sources, such as rainwater.

The findings further show a remarkable 17% of migrants both unemployed and not economically active using river/stream water as the alternative water source. This implies that migrants with financial struggles are most likely to access their water from open water sources such as rivers and streams as their alternative water sources.

The association between alternative water sources and employment status in metropolitan areas was tested. The findings show a p-value of 0.194. which is greater than the standard value of 0.05. This indicates that there is no significant relationship in metropolitan areas between alternative water sources and employment status.

Fig. 4.5.4 Distribution of alternative water sources by employment status in metropolitan areas



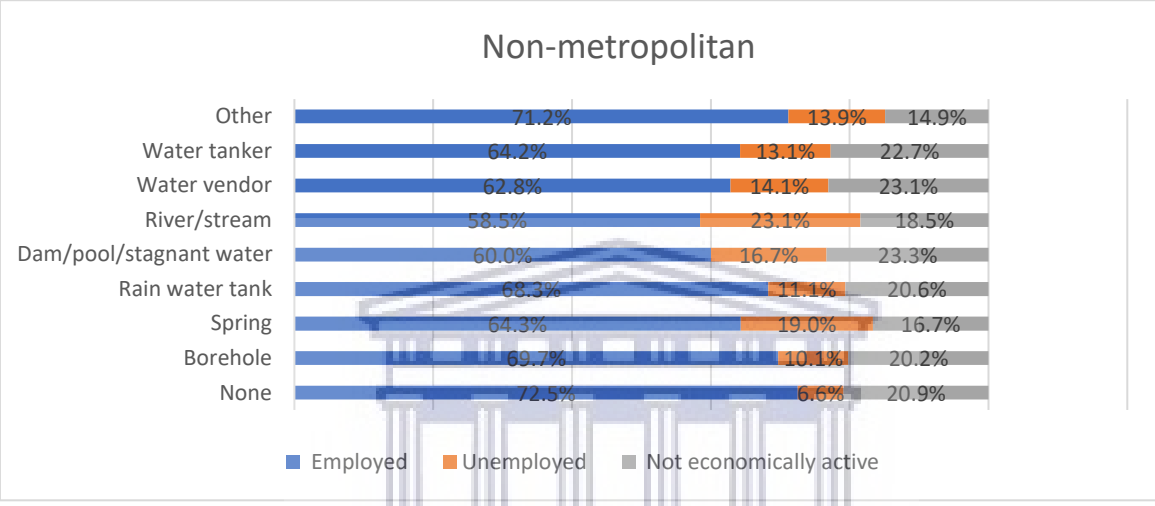
4.9.4.2 Alternative water sources by employment status in non-metropolitan areas

Figure 4.5.5 below portrays the findings on migrants' use of alternative water sources in non-metropolitan areas in respect of their employment status. The data shows that 70% of employed migrants use boreholes as their alternate water source, followed by 20% of those who are not economically active, and lastly 10% of unemployed migrants. This could be due to the financial costs involved in the installation of this water source. Hence, employed migrants are more likely to use it as their alternative water source because they might be able to afford it, unlike other migrants with different status.

The results show a slight increase in unemployed migrants using spring water as the alternative water source (19%) and a decrease in employed migrants (64%). This implies that unemployed migrants are more likely to use water from an open water source available at no cost. The findings also show an increase in use of water from rivers/streams, 59% of employed migrants, and a remarkable 23% of unemployed and 19% of those not economically active. Regarding water from water vendors, employed migrants had a high access rate of 63%, while only 23% of migrants outside labour market, and just 14% of unemployed migrants used such water. This suggests that migrants with disposable income are more likely to buy water from water vendors

than those with no jobs. Chi-square test statistics was also used to test the relationship between alternative water sources in non-metropolitan areas and migrants' employment status. The outcome showed a p-value of 0.138, which is greater than the standard value of 0.05. There is no relationship between alternative water sources in non-metropolitan areas and migrants' employment status.

Fig. 4.5.5 Distribution of alternative water sources by employment status in non-metropolitan areas



4.9.5 Access to alternative water sources by level of income across areas of residence

4.9.5.1 Alternative water sources by level of income in metropolitan areas

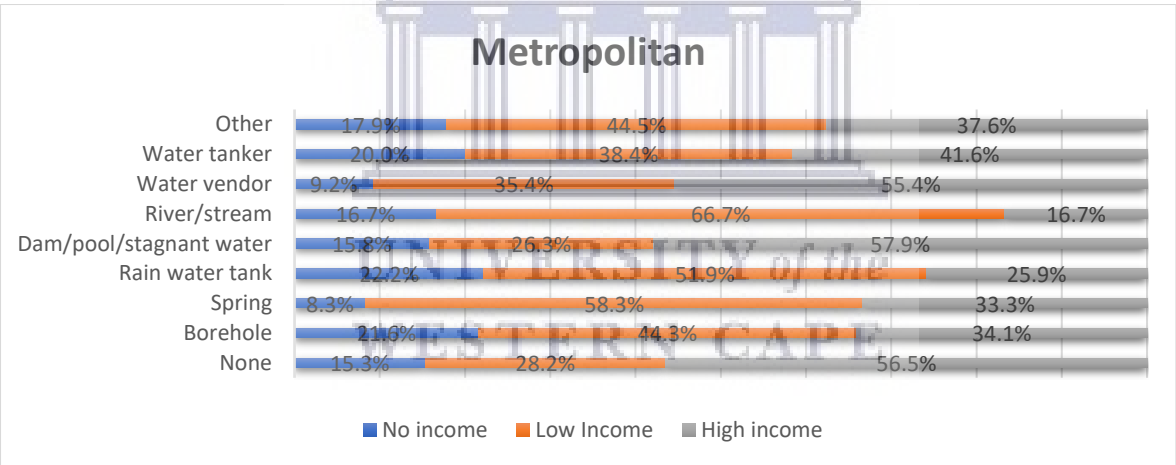
The results below in figure 4.5.6 show the output from cross-tabulation between alternative water sources in metropolitan areas and the migrants' level of income. The findings depict that more than half of migrants earning high income did not have any alternative water sources (57%), followed by 28% of those earning low income, and 15% of those with no income at all. Surprisingly, the majority of migrants using boreholes as alternative water sources were migrants with low income (44%).

The findings also show that unemployed migrants are more likely to access water from springs in open water sources. Migrants with no income showed significant figures regarding the access to rainwater tank as the alternative water source with 22.2%, while 52% of migrants with low income, and 26% of those earning high income. This shows that migrants with low and no income tend to use rainwater tanks as the alternative water source as they might not need to pay for access.

Looking at access from water vendors, the findings illustrate that migrants earning high income are more likely to buy water from water vendors, followed by those with low income, and at the least those with no income with 55%, 35%, and 9% respectively. The variation may be due to the income status of migrants. Migrants with high income can afford to buy water from water sellers should they run out of access from their usual water sources.

The study has used a Chi-square statistical test to assess the relationship between alternative water sources and migrants' level of income in metropolitan areas. The findings showed p-value of 0.000, which means that there is a significant relationship between alternative water sources and migrants' level of income in metropolitan areas. To measure the strength of the relationship between alternative water sources and level of income, the study used Lambda, Phi and Cramer's V in metropolitan areas. The results show no association (0.000) between the variables.

Fig. 4.5.6 Distribution of alternative water sources by level of income in metropolitan areas



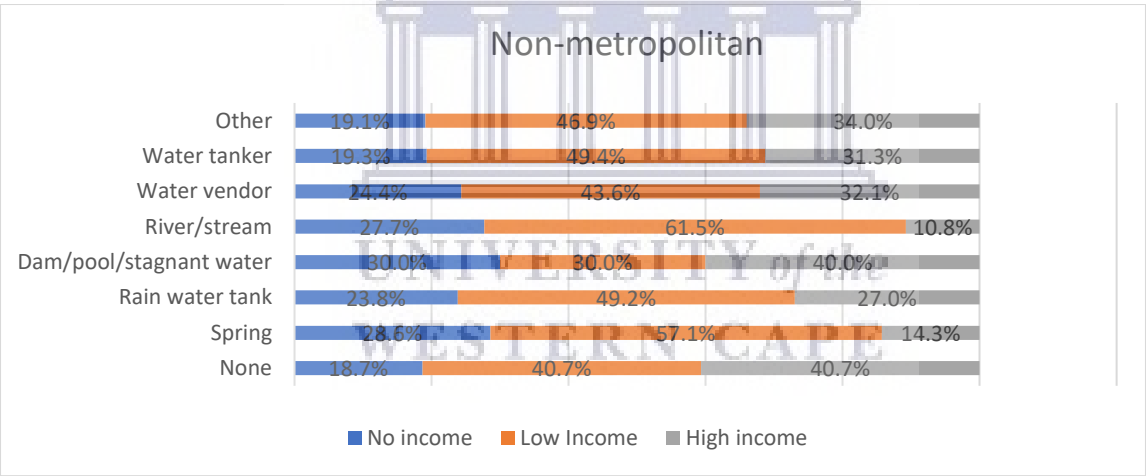
4.9.5.2 Alternative water sources by level of income in non-metropolitan areas

The findings displayed in figure 4.5.7 below show the variations of migrants' access to alternative water sources in non-metropolitan regions based on their level of income. Looking at access from spring water as the alternative source, migrants with low income dominates the usage of water from spring with 57%, followed by 29% of migrants with no income, and just 14% of those with high income. This suggests that migrants with high income are not likely to use water from spring as their alternative source, while migrants with low and no income are most likely to access water to open water sources. This is because migrants with high income

can afford water from improved sources. This is also apparent from using river/stream water. 62% of migrants with low-income access water from river/stream as their alternative supply, followed by migrants with no income (28%), and just 11% of migrants with high income.

A Chi-square test was performed to test the relationship between alternative water sources and migrants' level of income in non-metropolitan areas. The findings showed 0.001 of p-value. Therefore, since the p-value is less than the standard value of 0.05, this means that there is a significant relationship between alternative water sources and migrants' level of income in non-metropolitan areas. To measure the strength of the relationship between alternative water sources and level of income, the study used Lambda, Phi and Cramer's V in non-metropolitan areas. The findings from Lambda (0.513) show a very strong association between the variables. However, the results from Phi and Cramer's V show a very weak association (0.001) between the variables.

Fig. 4.5.7 Distribution of alternative water sources by level of income in non-metropolitan areas



4.9.6 Access to alternative water sources by age groups across areas of residence

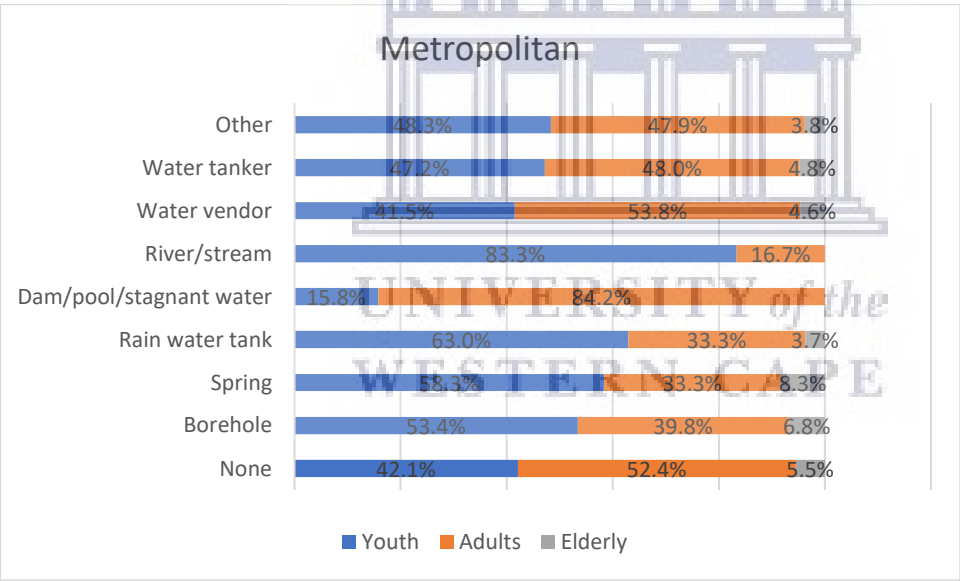
4.9.6.1 Alternative water sources by respect of age group in metropolitan areas

The study has also examined the number of migrants in non-metropolitan areas using alternative water sources in respect of their age group. Looking at the migrants that had no alternative water sources, the findings show that 52.4% of adult migrants did not have alternate water sources in metropolitan areas, followed by 42.1% of youth and 5.5% of elderly people. However, the findings indicate that young and adult migrants have better access to alternative water sources.

Looking at boreholes as the alternative water source, the findings show that majority of youth migrants (53.4%) used them, followed by 39.8% of adult migrants and just 6.8% of elderly migrants. Considering stagnant water such as dam/pool as the alternative water source, the results show 84.2% of adult migrants, followed by only 15.8% of youth migrants. 83.3% of youth migrants and 16.7% of adult migrants used rivers/streams as their alternative water source.

The study has used a Chi-square statistical test to examine the association between access to alternative water source and migrants' age group in metropolitan areas. The findings show a p-value of 0.061, which is greater than the standard value of 0.05. Therefore, this suggests that there is no significant relationship between access to alternative water sources and migrants' age group in non-metropolitan areas. This suggests that migrants' access to alternative water sources is not determined by age in metropolitan areas.

Fig 4.5.8 Distribution of alternative water sources by age group in metropolitan areas



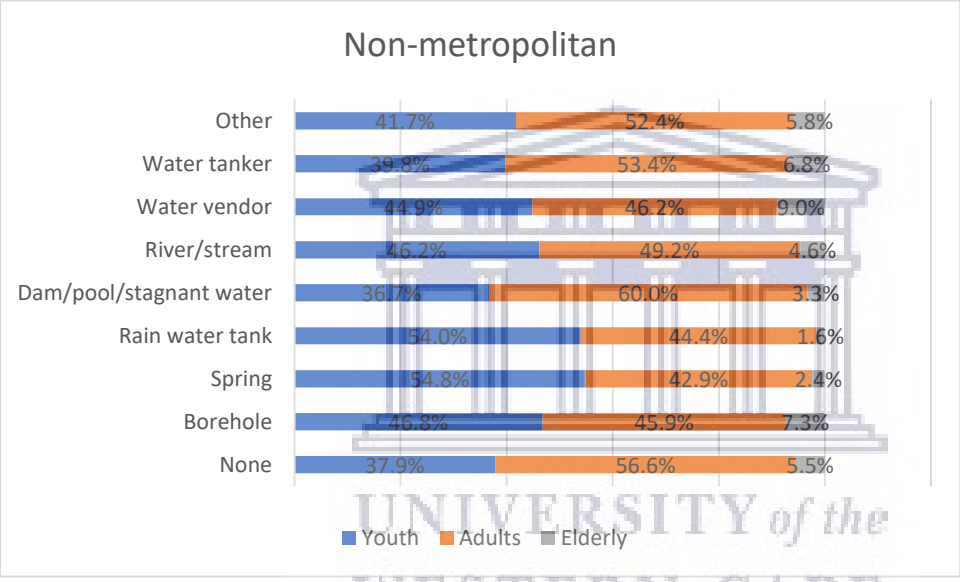
4.9.6.2 Alternative water sources by age group in non-metropolitan areas

The study has also examined alternative water sources in non-metropolitan areas and migrants' age groups. Looking at the number of migrants with no alternative water sources in non-metropolitan areas, 56.6% of adult migrants is the large group that did not have alternative water sources followed by 37.9% of youth and 5.5% of elderly migrants. 46.8% of youth migrants used borehole as the alternative water source followed by 45.9% of adult migrants

and 7.3% of elderly migrants. The outcome generally shows that adult and youth migrants in non-metropolitan areas are likely to use unprotected alternative water sources.

To examine the relationship between access to alternative water sources and migrants' age group in non-metropolitan areas, the study has used a Chi-square test. The findings show a p-value of 0.530, which is greater than a standard value of 0.05. Thus, this implies that there is no significant relationship between alternative water sources and migrants' age group in non-metropolitan areas. This means that access to alternative water sources is not determined by migrants' age in non-metropolitan areas.

Fig 4.5.9 Distribution of alternative water sources by age group in non-metropolitan



4.9.7 Access to alternative water sources by across areas of residence

4.9.7.1 Alternative water sources by duration of residence in metropolitan areas

Table 4.6.1 below illustrates a distribution of the access to the alternative water sources and the duration of stay both in metropolitan and non-metropolitan areas. Looking at metropolitan areas in 2001-2004, the output shows that stagnant water (36.8%) was the most used alternative water source, which was followed by the adaptation of boreholes (19.3%). Migrants buying water from water vendors and those using water tanks were almost equal in proportion (18.5% and 18.4% respectively). In 2005-2008, migrants were most likely to use spring water (50.0%) as their alternative water source, followed by those using rainwater tank and buying water from water vendors (37.0% and 36.8% respectively). In 2009-2011, the findings show that 47.9% of

migrants were using other alternative sources that are not depicted in the data, followed by those who had no alternative water sources (46.7%), and those using borehole (45.5%).

A Chi-square test was performed to test for a relationship between access to alternative water sources and the duration of residence. The findings showed a p-value of 0.692, which is greater than a standard value of 0.05. This means that statistically there is no significant relationship between alternative water sources and the duration of residence in metropolitan areas.

4.9.7.2 Alternative water sources by duration of residence in non-metropolitan areas

The duration for which one stays in an area plays a critical role in getting to know the resources around the area and it can influence the choice of water source for household consumption. Table 4.6.1 also shows the distribution of migrants' access to alternative water sources and the duration of residence in non-metropolitan areas. Looking at 2001-2004, the majority of migrants used water vendors as their alternative water source (23.1%), followed by those with no alternative access (17.6%), and 15.6% of those made use of borehole sources. In 2005-2008, migrants were most likely to use spring water (50.0%) as the alternative water source, followed by those buying water from water vendors (38.5%) and those alternating with rainwater tank (37.0%). In 2009-2011, many migrants were likely using alternative water source that are not depicted in the data being used in this study (47.9%), followed by those who had no alternative water sources to the ones they used (46.7%) and those that used boreholes (45.5%).

To test for a statistical association, Pearson Chi-square test was performed. The test result was p-0.016, which was found to be less than a standard value of 0.05. Therefore, this means that we have enough statistical evidence that there is a relationship between alternative water sources and the duration of residence. To measure the strength of the association between alternative water sources and the duration of residence in non-metropolitan areas, the study used Lambda, Phi and Cramer's V. Lambda test show a very strong association (0.423) between the variables, while Phi and Cramer's V show a very weak association (0.016) between alternative water sources and the duration of residence in non-metropolitan areas.

Table 4.6.1 Distribution of access to alternative water sources and duration of residence in metropolitan and non-metropolitan areas

METROPOLITAN									
Duration of residence	**None**	**Borehole**	**Spring**	**Rain-water tank**	**Dam/pool/stagnant water**	**River/stream**	**Water vendor**	**Water tanker**	**Other**
2001-2004	16,5%	19,3%	8.3%	29,6%	36,8%	-	18,5%	18,4%	15,7 %
2005-2008	36,8%	35,2%	50,0%	37,0%	26,3%	-	38,5%	36,8%	36,4 %
2009-2011	46,7%	45,5%	41,7%	33,3%	36,8%	-	43,1%	44,8%	47,9 %
NON-METROPOLITAN									
2001-2004	17,6%	15,6%	7.1%	14,3%	13.3%	6.1%	23.1%	15,3%	14,6 %
2005-2008	36,8%	35,2%	50,0%	37,0%	26,3%	-	38,5%	36,8%	36,4 %
2009-2011	46,7%	45,5%	41,7%	33,3%	36,8%	-	43,1%	44,8%	47,9 %

Source: Author's own calculations from 10% of the 2011 Census data

4.10 Reliability of water supply in metropolitan and non-metropolitan areas

One of the objectives of this study is to determine whether the reliability of water supply is influenced by migrants' characteristics across areas of residence. Migrants were asked about the reliability of the water supply whether the supply was consistent or not. This study examines the relationship between reliability of water supply and individual characteristics of migrants across metropolitan and non-metropolitan areas.

4.10.1 Reliability of water supply by population groups across areas of residence

4.10.1.1 Reliability of water supply by population groups in metropolitan areas

The reliability of water supply was assessed to examine the relationship between population groups and reliability of water supply in metropolitan areas. The findings show that the white population (53%) in metropolitan areas have a more reliable water supply than other population groups. This implies that unequal service distribution, from the apartheid system, is still a predominant feature in South Africa (Ngum, 2011). The findings show that Black migrants in metropolitan areas have a more unreliable water supply (50.3%) than other population groups. The majority of Black/African and Coloured migrants had an unreliable water supply as compared to Whites and Indian/Asian migrants.

A Chi-square statistical test was performed to examine the relationship between the reliability of the water supply in metropolitan areas and migrants' population groups. The findings showed a p-value of 0.000 between the above-mentioned variables. Since the p-value of 0.000 is less than the standard value of 0.05, this means there is an existing relationship between reliability of water sources and population groups in metropolitan areas. To measure the strength of the association between the reliability of water sources and the population group in metropolitan areas, the study used Lambda, Phi and Cramer's V. The findings in all the tests show no relationship (0.000) between the variables.

4.10.1.2 Reliability of water supply by population groups in non-metropolitan areas

Looking at the reliability of water supply in non-metropolitan areas across population groups, the results portrayed in Table 4.7 show a change from the findings in non-metropolitan areas. A Chi-square statistical test was used to test the relationship between the reliability of water supply and population groups among migrants in non-metropolitan areas. The outcome showed a p-value of 0.098, which is greater than the standard value of 0.05. Since the p-value is greater than the standard value, we have statistical evidence that there is no relationship between reliability of water supply in non-metropolitan areas and migrants' population groups.

Table 4.7 Reliability of water supply by population group in metropolitan and non-metropolitan areas

	Metropolitan				Non-metropolitan			
	Black/African	Coloured	Indian/Asian	White	Black/African	Coloured	Indian/Asian	White
Yes	35.3%	3.8%	7.6%	52.8%	51.1%	2.8%	3.2%	43.0%
No	50.3%	5.5%	5.9%	38.3%	55.3%	5.1%	2.3%	37.3%

Source: Author's own calculations from 10% of the 2011 Census data

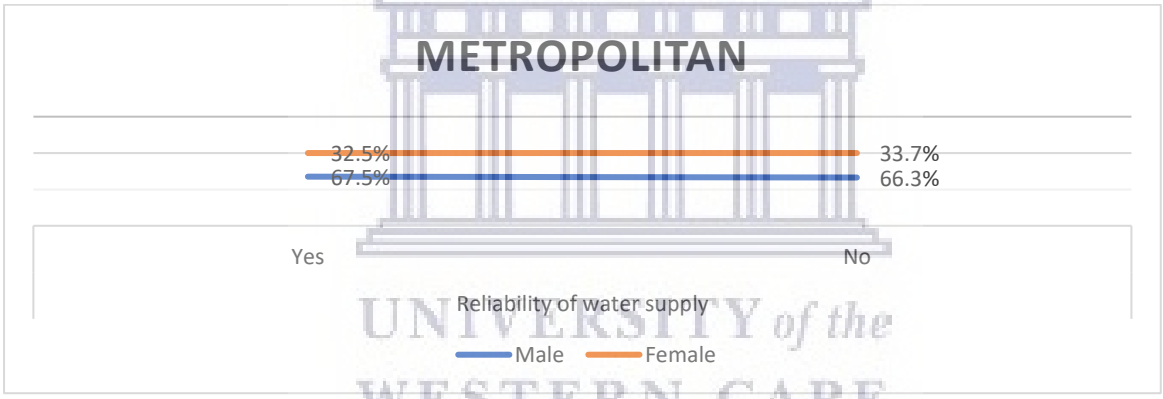
4.10.2 Reliability of water supply by gender across areas of residence

4.10.2.1 Reliability of water supply by gender in metropolitan areas

Figure 4.6 below shows the findings on reliability of water supply between male and female migrants in metropolitan areas. The findings show that more male migrants have consistent water supply than females. This shows a gender imbalance, female migrants being disadvantaged compared to males. This may be due to other factors such as economic aspects, as females may be less likely to afford reliable water compared to males.

To test the relationship between reliability of water supply and gender difference in metropolitan areas, a Chi-square statistical test was performed. The findings showed a p-value of 0.154, which is greater than the standard value of 0.05. Therefore, this means that there is no association between reliability and gender in metropolitan areas.

Fig. 4.6 Reliability of water supply by gender in metropolitan areas

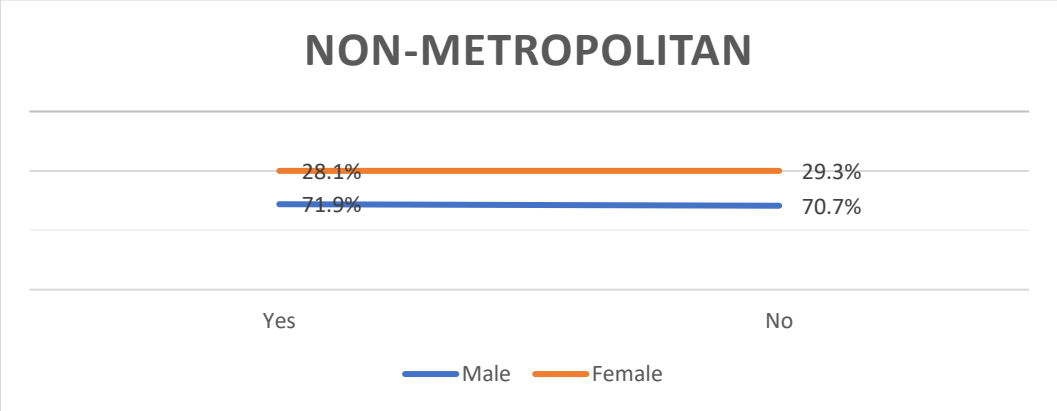


4.10.2.2 Reliability of water supply by gender in non-metropolitan areas

Figure 4.6.1 portrays the findings about the reliability of water supply and gender differences in non-metropolitan areas. The results also show that water supply is more reliable for males than for females in non-metropolitan areas. This is suggested by the figures given by males (72%) and females (28%) reporting reliability.

The Chi-square test statistic, testing a relationship between reliability of water supply and gender difference in non-metropolitan areas, was performed. The findings showed a p-value of 0.346, which is greater than the standard value of 0.05. Since the p-value is greater than the standard value of 0.05, this means that there is no significant relationship between reliability of water supply and migrants' gender status in non-metropolitan areas.

Fig. 4.6.1 Reliability of water supply by gender in non-metropolitan areas



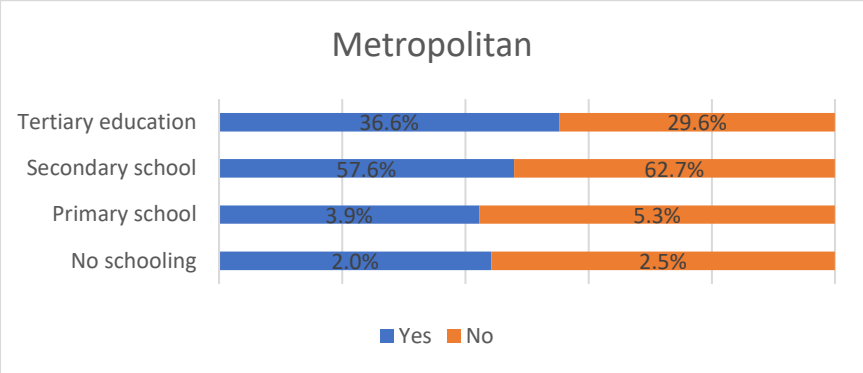
4.10.3 Reliability of water supply by level of education across areas of residence

4.10.3.1 Reliability of water supply by level of education in metropolitan areas

Level of education remains an informative demographic variable when it comes to reliability of water supply. It was used to assess to what extent water supply was reliable in metropolitan regions. Figure 4.6.2 shows how water was reliable among migrants by level of education. The findings show that migrants with no schooling, primary education, and secondary education experience unreliability of water supply in metropolitan areas. Conversely, migrants with tertiary education are most likely to have reliable water supply in metropolitan areas. This is possibly because educated migrants are most likely to stay in areas where water is not interrupted often, such as in suburb areas, whereas the majority of migrants with limited education are most likely to stay in areas where water is interrupted often, such as in townships and in informal settlements.

To test the relationship between reliability of water supply and migrants' level of education in metropolitan areas, a Chi-square test was performed. The study showed a p-value of 0.000, which is less than the cut-off value of 0.05. Thus, we have statistical evidence that there is a relationship between the reliability of water supply and migrants' level of education in metropolitan areas. This means that migrants' level of education can determine the reliability of their water supply. The study used Lambda, Phi and Cramer's V tests to measure the strength of the association between the variables stated above. The findings show a weak association (0.000) between the variables.

Fig. 4.6.2 Reliability of water supply by level of education in metropolitan areas

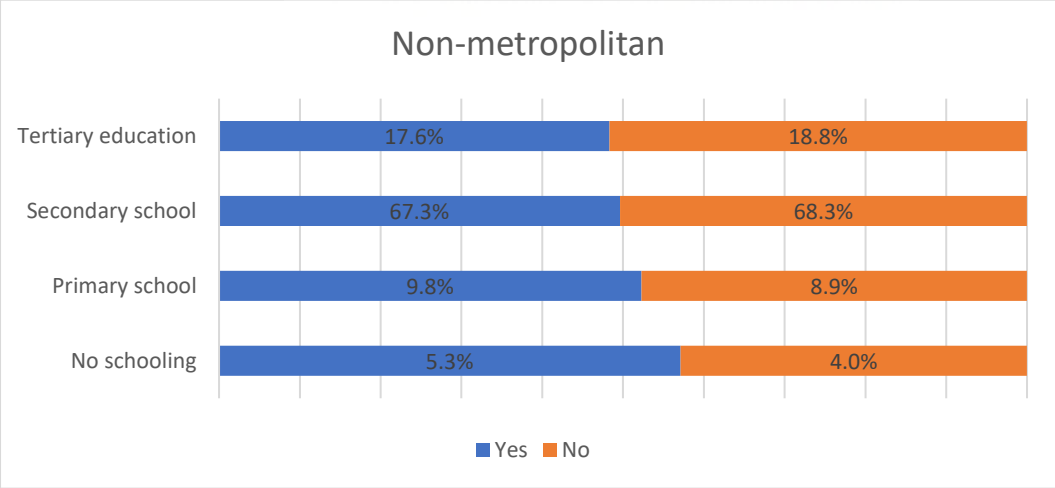


4.10.3.2 Reliability of water supply by level of education in non-metropolitan areas

The findings about the level of education and reliability of water sources in non-metropolitan areas are depicted in figure 4.6.3 below. Looking at the results, there are no significant differences between reliable and unreliable water supply in these categories. This implies that education does not necessarily relate to accessing a reliable water supply in non-metropolitan areas.

A Chi-square test was used to assess the relationship between the reliability of water supply and migrants' level of education in non-metropolitan areas. The findings support the above argument that there is no significant relationship between the variables ($p=0.098>0.05$).

Fig. 4.6.3 Reliability of water supply by level of education in non-metropolitan areas



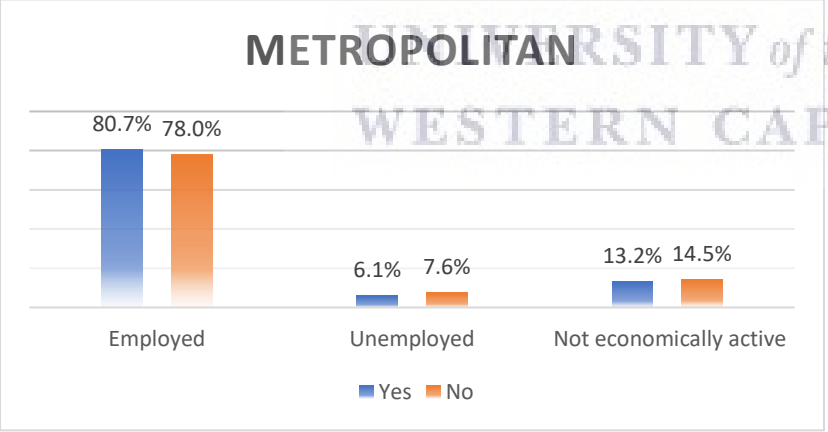
4.10.4 Reliability of water supply by employment status across areas of residence

4.10.4.1 Reliability of water supply by employment status in metropolitan areas

Figure 4.6.4 shows the relationship between the reliability of water supply in metropolitan areas and migrants' employment status. It is apparent from the results that employed migrants are more likely to have a stable reliable water supply than migrants with no employment and those who are not economically active. This is because employed migrants afford to pay for water bills and likely to stay in areas with less disruption in water supply. On the other hand, unemployed and economically inactive migrants are more likely to live in areas inclined to experience unreliable water supply by local municipalities.

A Chi-square test was performed to examine the relationship between reliability of water supply in metropolitan areas and migrants' status of employment. The findings show a p-value of 0.000, which is less than the standard value of 0.05. Since the p-value is less than the standard value, the findings show that there is a relationship between reliability of water supply and migrants' employment status in these areas. Lambda, Phi and Cramer's V were used to measure the strength of the association. The tests show that there is a very weak association (0.000) between the variables.

Fig. 4.6.4 Reliability of water supply by employment status in metropolitan areas



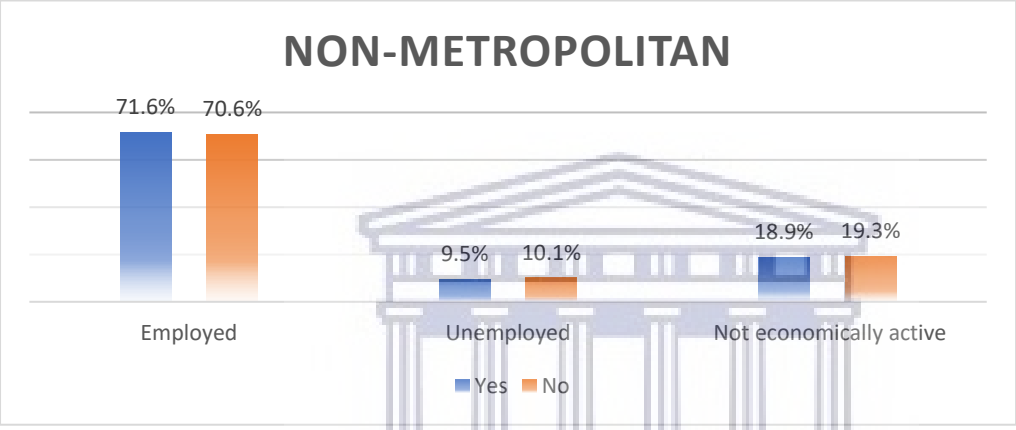
4.10.4.2 Reliability of water supply by level of employment status in non-metropolitan areas

The study cross-tabulated reliability of water supply and migrants' employment status to examine the association between water supply in non-metropolitan areas and migrants' employment status. It is evident from the findings portrayed in figure 4.6.5 that migrants, irrespective of their employment statuses, have equal chances of experiencing reliability or

unreliability of water supply in non-metropolitan regions. This suggests that access to reliable water supply is not influenced by level of education.

To test the relationship between reliability of water supply and employment status in non-metropolitan areas, the study has used a Chi-square statistical test. The output showed a p-value of 0.723. Since the p-value (0.073) is greater than the standard value of 0.05, statistically, there is no relationship between the reliability of water supply in non-metropolitan areas and migrants' employment status.

Fig. 4.6.5 Reliability of water supply by employment status in non-metropolitan



4.10.5 Reliability of water supply by level of income across areas of residence

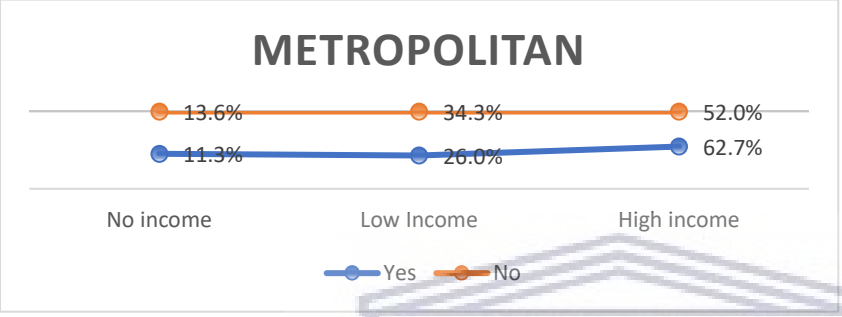
4.10.5.1 Reliability of water supply by level of income in metropolitan areas

Employment status might be a social demographic characteristic which influences whether migrant-headed households have reliable water supplies. Figure 4.6.6 below depicts the reliability of water supply among migrants based on their level of income in metropolitan areas. It is clear that migrants with no income and those with low income are likely to experience unreliable water supply. Contrary, migrants with high incomes are likely to have reliable supply (62.7%). This shows that there are variations in access to reliable water supply according to level of income.

A Chi-square test was performed to investigate the relationship between the reliability of water supply and migrants' level of income in metropolitan regions. The findings showed a p-value of 0.000, which is less than the cut-off value of 0.05. This means that we have statistical

evidence to conclude that there is a significant relationship between reliability of water supply and migrants' level of income in metropolitan areas. To measure the strength of the association between the reliability of water supply and migrants' level of income in metropolitan areas, the study used Lambda, Phi and Cramer's V. The findings in all the tests show no strength (0.000) in the association between the variables.

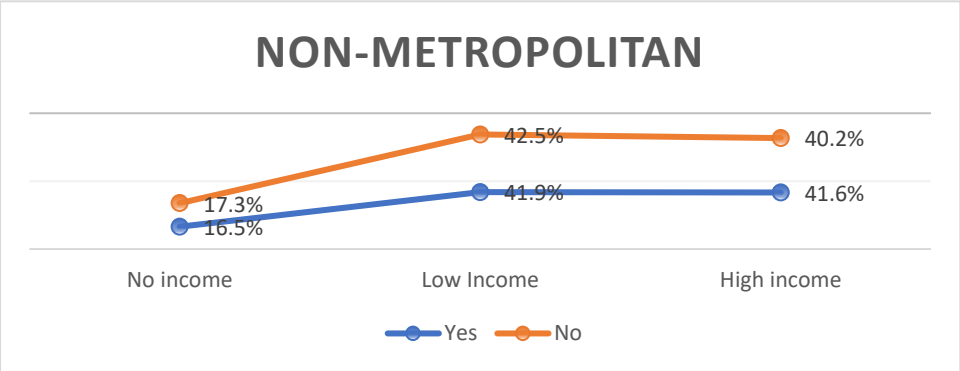
Fig. 4.6.6 Reliability of water supply by level of income in metropolitan areas



4.10.5.2 Reliability of water supply by level of income in non-metropolitan areas

Figure 4.6.7 shows the reliability of water supply among migrants in non-metropolitan areas based on their level of income. It is evident from the findings that there is no significant variation between reliability and unreliability water supply based on income. A Chi-square statistical test was performed to determine the relationship between the reliability of water supply and migrants' level of income in non-metropolitan areas. The findings show a p-value of 0.582, which is greater than the standard value of 0.05. Since the p-value is greater than the standard value of 0.05, the test means that there is no relationship between reliability of water supply and migrants' level of income in non-metropolitan areas as opposed to metropolitan areas.

Fig. 4.6.7 Reliability of water supply by level of income in non-metropolitan areas



4.10.6 Reliability of water supply by across areas of residence

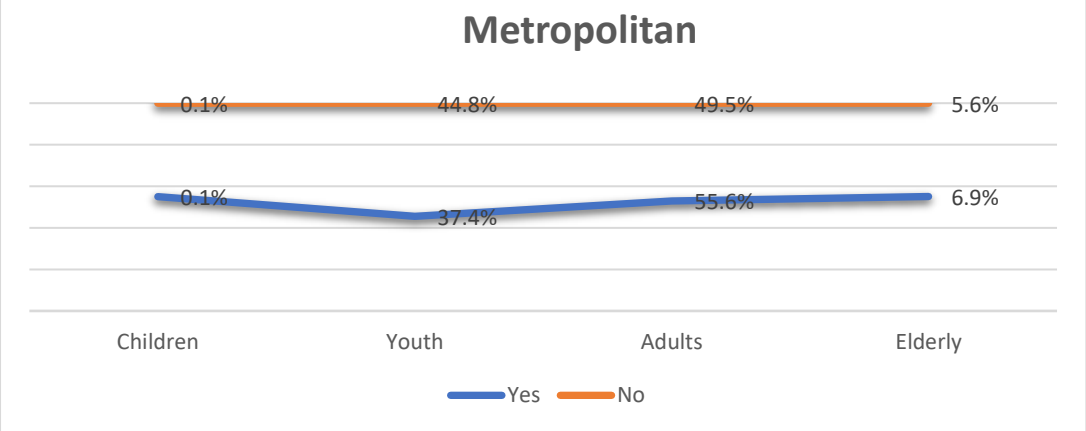
4.10.6.1 Reliability of water supply by age group in metropolitan areas

Based on migration selectivity theory, age plays a fundamental role in migration and it can be a determining factor of how water is accessed as a scarce resource. The findings show that adults (55.6%) and elderly 6.9%) migrants are likely to have reliable water supply in metropolitan areas, as it was only 49.5% and 5.6%, respectively, who had unreliable water supply in metropolitan areas. The majority of young migrants (15-35) had an unreliable water supply (44.8%). This may be because young migrants in most cases live in informal settlements, where public services in general, and water supply in particular, are an issue.

The findings show that many young migrants (15-35 years) find water supply not reliable (44.8%) in their areas of destinations, compared to the 37.4% of those that found water supply reliable. On the other hand, the study shows that adults are more likely to find water supply reliable: 55.6% against 49.5% of those found it not reliable.

To assess the relationship between reliability of water sources and age group in metropolitan areas, the study used a Chi-square test statistic. The findings show a p-value of 0.000, which is less than the standard value of 0.05. This suggests that there is a significant relationship between the reliability of water sources and age group in metropolitan areas. Therefore, this implies that migrants' age group determines reliability of water supply in their areas of destinations. The study used Lambda, Phi and Cramer's V to measure the strength of the association between the reliability of water sources and age group in metropolitan areas. The findings show a very weak association (0.000) between the variables in all the tests.

Fig. 4.6.8 Reliability of water supply by age group in metropolitan areas

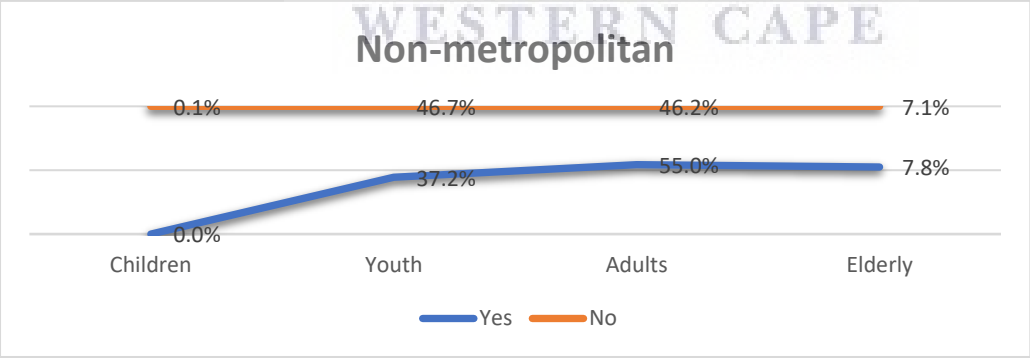


4.10.6.2 Reliability of water supply by age group in non-metropolitan areas

This study examined the relationship between reliability of water supply and age groups in non-metropolitan areas. Figure 4.6.9 shows that water supply among youth living in non-metropolitan areas is not reliable (46.7%), as opposed to the 37.2% who found it reliable. However, adult migrants are likely to have reliable water supply.

A Chi-square test was used to examine the relationship between the reliability of water supply and age group in non-metropolitan areas. The findings reveal that there is a significant relationship between the reliability of water supply and migrants' age groups in non-metropolitan areas with a p-value of 0.000, which is less than the standard value of 0.05. Therefore, we have a statistical evidence that there is a significant relationship between these two variables. This implies that the age of migrants in non-metropolitan areas determines the likelihood of having access to reliable water sources. The study used Lambda, Phi and Cramer's V to measure the strength of the association between the reliability of water sources in non-metropolitan areas and age group. The results from Lambda (0.781) show a very strong relationship between the variables. However, the findings from Phi and Cramer's show no strength (0.000) in the association between water supply reliability in non-metropolitan areas and migrants' ages.

Fig. 4.6.9 Reliability of water supply by age group in non-metropolitan areas



4.10.7 Reliability of water supply by duration of stay across areas of residence

4.10.7.1Reliability of water supply and duration of residence in metropolitan areas

To discover the relationship between the reliability of water supply and the duration of residence, the two variables were cross-tabulated. Looking at the metropolitan areas, the results depicted in Table 4.7.1 below show that from the year 2001 to 2011 the water supply was most likely to be reliable for migrants over the years. The findings show an increase in the reliability of water supply over the years. However, there were also remarkable numbers of migrants who experienced an unreliable water supply over the years: 29.9% in 2005-2008, and up to 51.3% in the period 2009-2011.

Looking at the Chi-square test statistic for association, the findings show a statistical significance, as a p-value of 0.000 was less than a standard value of 0.05. This means that the longer the stay, the more likely that migrants who live in metropolitan areas have access to a reliable water supply. To measure the strength of the association between the reliability of water supply and migrants' duration of residence in metropolitan areas, the study used Lambda, Phi and Cramer's V tests. The findings from the tests show no strength (0.000) in the association between the variables.

4.10.7.2 Reliability of water supply and duration of residence in non-metropolitan areas

Table 4.7.1 below displays the findings concerning the reliability of water supply and migrants' duration of residence in non-metropolitan areas. The findings reveal that during the periods 2001-2004 and 2005-2008, migrants reported the reliability of the water supply (15.8% and 33.4% respectively). By contrast, water supply was more likely not to be reliable for many migrants from 2009-2011 (62.3%), while 50.7% reported it to be reliable during this period. Meaning that water becomes less reliable over time, possibly due to an increase of users in non-metropolitan areas.

The study has also used a Chi-square test to examine the relationship between the reliability of water supply and the duration of residence in non-metropolitan areas. The test results showed a p-value of 0.000. Therefore, we have enough statistical evidence that there is a significant relationship between the reliability of water supply and the duration of residence in non-metropolitan areas. To measure the strength of the association between the reliability of water

supply and migrants' duration of residence in non-metropolitan areas, the study used Lambda, Phi and Cramer's V tests. The findings from the tests show no strength (0.000) in the association between the reliability of water supply and the duration of residence in the non-metropolitan areas.

Table 4.7.1 Distribution of reliability of water supply and duration of residence in metropolitan and non-metropolitan areas

METROPOLITANS		
Reliability of water supply	Yes	No
2001-2004	19,5%	15,3%
2005-2008	36,6%	29,9%
2009-2011	54,8%	51,3%
NON-METROPOLITANS		
Reliability of water supply	Yes	No
2001-2004	15,8%	12,5%
2005-2008	33,4%	25,2%
2009-2011	50,7%	62,3%

Source: 10% of the 2011 Census data

4.11 Logistic regression on access to piped water across areas of residence

4.11.1 Factors associated with access to piped water across metropolitan areas

In addition to the data analysis through cross-tabulation and Chi-square tests to examine the association between migration and access to water across areas of residences, logistic regression statistical analysis was carried out to identify the factors contributing to water access in metropolitan and non-metropolitan areas of South Africa. Hence, Table 4.7 below shows the results from logistic regression model. The omnibus tests of model coefficients were significant, with p-value of 0.000, and -2 log likelihood revealed that the data fits well the model. The column called Exp.(B) shows the odds ratios (OR) for the dependent and independent variables.

When looking at metropolitan areas, the results show that the OR for male is 1.401. This means that male migrants living in metropolitan areas are more likely to have access to piped water inside the dwelling than female migrants. These results, however, indicate that the likelihood of accessing piped water inside the dwelling in metropolitan areas is influenced by gender differences. Therefore, this implies that being a male migrant increases the chances of accessing piped water compared to females. This suggests that even in post-apartheid South

Africa, disparities still exist between genders, males being more privileged than their female counterparts. As stated by the South African Human Rights Commission (SAHRC) (2019), women have been marginalised and regarded as unequal as compared to men in terms of social and power relations. Considering the age groups, the OR for children is 8.566; for youth is 2.636; and for adult migrants is 1.955. This means that the odds of having access to piped water inside the dwelling increases by age group. Looking at the population groups, the data shows that being Black increases the chances of accessing piped water in metropolitan areas to 3.561 times higher than for whites. This supports the argument by Ngum (2011) that in an attempt to correct the imbalances of the past (apartheid regime), new policies that promoted equality and human dignity were adopted by the post-apartheid government. Level of education is also significant. The OR for migrants with no formal schooling is 3.448, for primary education is 5.104, and is 2.270 for secondary schooling. This means that migrants with no schooling, basic or secondary education living in metropolitan areas are more likely to have access to piped water inside the dwelling than those with higher education. The findings also indicate that being a migrant with no income or a low income increases the chances of accessing piped water more than those with a high level of income with 5.156 and 3.942 odds respectively. This implies that the government is giving a hand to disadvantaged groups of people. With regards to the duration of residence, the study showed the OR of 1.574 for a period of 2001-2004 and 1.360 for 2005-2008. This means that migrants during these periods were most likely to access piped water inside the dwellings than those in 2009-2011. Finally, the findings show the significance of the provinces of previous residence. Migrants from the Eastern Cape, Free State, KwaZulu-Natal, and Limpopo have chances of accessing piped water in metropolitan areas that are 2.516, 2.879, 1.608, and 1.606 times higher respectively.

4.11.2 Factors contributing to migrants' access to piped water in non-metropolitan areas

Further, data analysis was carried out to explore the factors contributing to piped water in non-metropolitan areas. Table 4.7 below shows there are fewer factors contributing to access to piped water here, compared to metropolitan areas. Sex (gender) is one of the important factors influencing the access to piped water. Findings illustrate that being male increases the chances of accessing piped water inside the house by 1.205 times more than females in non-metropolitan areas. As in the metropolitan areas, this is also the case in the non-metropolitan areas. This implies that female migrants have less access to piped water than their male counterparts. Population group was also significant in the findings. Being Black, Coloured, and Indian migrants in non-metropolitan areas increases chances of accessing piped water inside

their dwelling to 5.849, 2.085, and 3.631 times higher than whites respectively. Level of education is another factor that influences the likelihood of being able to access piped water inside the dwelling in non-metropolitan areas. Surprisingly, findings indicate that migrants with no schooling, primary schooling, and secondary education increase the possibility of accessing piped water inside their dwellings by 3.405, 3.582, and 2.431 times, respectively, more than those with tertiary education. The results also reveal the likelihood of accessing piped water inside the dwelling by level of income. Migrants with no income increase their chances of accessing piped water inside their dwellings by 3.653 times more than those with high income, while those with lower income increase their chances by 2.772 times. This means that migrants with no income or with lower income are likely to access piped water inside their premises because, as they do not afford water bills, the government gives them free access, unlike those who can afford to pay for water. Table 2 further indicates that being unemployed is a contributing factor to the likelihood of a migrant accessing piped water inside the dwelling. The findings show that being unemployed increases the chances of accessing piped water inside the dwelling by 1.350 times more than those who are not economically active. This may be because the government provides basic services free or at a lower rate to those who cannot afford access.

Table 4.8 Logistic regression output on access to piped water by migrants' demographic and socio-economic variables in metropolitan and non-metropolitan area

	Metropolitan				Non-metropolitan			
	B	Wald	Sig.	Exp(B)	B	Wald	Sig.	Exp(B)
Sex								
Male	0,337	15,926	0,000	1,401	0,187	4,623	0,032	1,205
Female@								
Age group		23,225	0,000			1,852	0,604	
Children	2,147	7,542	0,006	8,556	0,714	0,480	0,488	2,042
Youth	0,969	10,375	0,001	2,636	-0,013	0,003	0,960	0,988
Adults	0,670	5,015	0,025	1,955	0,086	0,124	0,725	1,089
Elderly@								
Population group		111,078	0,000			146,200	0,000	
Black/African	1,270	77,562	0,000	3,561	1,766	138,042	0,000	5,849
Coloured	-0,078	0,062	0,803	0,925	0,735	6,484	0,011	2,085
Indian/Asian	-0,505	1,917	0,166	0,604	1,290	19,707	0,000	3,631
White@								
Level of Education		91,242	0,000			40,024	0,000	
No Schooling	1,238	25,250	0,000	3,448	1,225	26,590	0,000	3,405
Primary Schooling	1,630	78,142	0,000	5,104	1,276	34,386	0,000	3,582
Secondary Schooling	0,820	26,791	0,000	2,270	0,888	19,806	0,000	2,431
Tertiary level@								
Income group		112,969	0,000			71,199	0,000	
No Income	1,640	99,261	0,000	5,156	1,296	61,396	0,000	3,653
Lower Income	1,372	97,681	0,000	3,942	1,020	60,496	0,000	2,772
Higher Income@								
Employment status		6,526	0,038			4,867	0,088	
Employed	-0,169	1,762	0,184	0,844	0,075	0,335	0,563	1,078
Unemployed	0,155	1,275	0,259	1,167	0,300	4,515	0,034	1,350
Not economically active@								
Duration of residence		21,605	0,000			0,975	0,614	
2001-2004	0,453	17,021	0,000	1,574	-0,039	0,089	0,765	0,962
2005-2008	0,307	11,863	0,001	1,360	0,078	0,714	0,398	1,081
2009-2011@								
Province of usual residence		8,707	0,465			11,306	0,255	
Western Cape	0,385	1,170	0,279	1,470	0,016	0,003	0,960	1,016
Eastern Cape	0,478	1,764	0,184	1,612	0,450	2,290	0,130	1,568
Northern Cape	0,747	1,300	0,254	2,110	0,015	0,001	0,971	1,015
Free State	0,033	0,005	0,941	1,034	-0,009	0,001	0,979	0,991
KwaZulu-Natal	0,515	2,102	0,147	1,673	0,093	0,093	0,761	1,097
North West	0,305	0,270	0,603	1,357	-0,069	0,050	0,823	0,934
Gauteng	0,220	0,432	0,511	1,246	0,127	0,186	0,666	1,136
Mpumalanga	0,614	1,494	0,222	1,847	0,217	0,493	0,483	1,242
Limpopo	0,406	1,222	0,269	1,501	0,134	0,200	0,655	1,143
Outside SA@								
Province of previous residence		58,619	0,000			14,504	0,106	
Western Cape	0,207	0,918	0,338	1,230	-0,268	1,098	0,295	0,765
Eastern Cape	0,949	29,894	0,000	2,584	0,207	1,443	0,230	1,230
Northern Cape	0,491	1,424	0,233	1,634	0,381	1,435	0,231	1,464
Free State	1,088	18,638	0,000	2,967	-0,469	3,114	0,078	0,626
KwaZulu-Natal	0,509	7,509	0,006	1,664	0,090	0,238	0,625	1,094
North West	0,163	0,245	0,621	1,177	-0,029	0,022	0,882	0,971
Gauteng	0,131	0,778	0,378	1,140	-0,145	0,719	0,396	0,865
Mpumalanga	0,415	1,856	0,173	1,514	-0,073	0,129	0,719	0,930
Limpopo	0,490	6,849	0,009	1,632	0,130	0,542	0,462	1,139
Outside SA@								
Constant	-7,296	219,428	0,000	0,001	-5,148	138,287	0,000	0,006

4.12 Logistic regression on access to regional/local water schemes across areas of residence

4.12.1 Factors contributing to access water from regional/local water schemes in metropolitan areas

The data analysis was carried out to assess the factors that influence the likelihood of accessing water from regional or local water schemes in metropolitan areas. Table 4.8 below shows that an omnibus test of model coefficients was significant, with p=0.00<0.05 and -2 log likelihood, showing that the data fits the model. The data further show that being male increases chances of accessing regional/local water scheme in metropolitan areas by 1.280 times, compared to females. This implies that there are disparities between genders in provision of public services, with males seeming to receive more than their female counterparts. The results also show that population group is significant. Being a Black/African migrant increases the chances of accessing regional/local water schemes in metropolitan areas by 1.716 over whites.

Looking at the level of education, the results show that migrants with no education were significantly better off in terms of water access, with their chance of accessing water schemes 2.363 times higher compared to migrants with tertiary education. This is the case because these types of migrants are likely to reside in slum areas where they do not have to pay for municipal water (Ngum, 2011). In addition, having primary schooling increase the chances of accessing water from regional/local water schemes in metropolitan areas by 2.126 times more than the migrants with tertiary education. The assumption is that the lower level of education attainment increases the chances of accessing water from municipal water schemes because they could not afford access from any other water sources. The results also support this argument by indicating that being a migrant with no income increases the chances of accessing water from the regional/local schemes in metropolitan areas by 2.363 times over those with higher incomes. In addition, migrants with lower income had 2.255 chances greater compared to those with high income in accessing water from the regional/local water schemes provided by the local authorities. Lastly, the study has shown a level of significance in the province of usual residence and access. Being a migrant in the Western Cape, Free State, and Mpumalanga decreases the chance of accessing water in regional/local water schemes by 0.430, 0.389, and 0.256 times, respectively, more than those outside the country. This means that staying in these provinces does not automatically mean accessing water from regional or local water schemes. Migrants can access water from other alternative sources.

4.12.2 Factors contributing to source of water from regional/local water schemes in non-metropolitan areas

In the non-metropolitan areas, gender was significant. The results displayed in Table 4.8 show that males' chances of accessing regional water in non-metropolitan areas are 1.199 times higher than females. This, therefore, indicates that males have greater chances in accessing public services than females. This shows that there are still disparities in providing services on the basis of gender difference in South Africa. The findings also show that the level of education was significant in non-metropolitan areas. Being a migrant with no schooling and primary education increases the chances of accessing water from regional water schemes 1.808 and 1.946 times, respectively, over those with tertiary education. It is illustrated also in the result that migrants with no income or low income have chances 1.535 and 2.012 greater, respectively, of being provided with water by local authorities with than ones with high income. The results show that being employed migrants in these areas increases the possibility of accessing water from the regional water schemes to 1.282 times higher than those who are not economically active. This gives an indication that migrants in non-metropolitan areas should at least be employed to access water from the local water schemes. Looking at the provinces of usual residence, the findings show that being a migrant from the Western Cape decreases the chances of accessing water from regional water scheme by 0.568 times compared to migrants from outside South Africa. However, being a migrant living in Mpumalanga increases the likelihood of accessing water from regional water scheme to 1.972 times higher than migrants from outside South Africa.

Considering the access to water from regional water schemes based on province of previous residence, the results show the level of significance in Free State, North West, Gauteng, and Mpumalanga. Migrants from Free State have a 0.563 times higher chances of accessing water from regional water schemes. Both North West and Gauteng offer 0.717 and 0.750 times less chance respectively than those outside the country; and Mpumalanga offers a 0.700 times higher chance than those from outside South Africa.

Table 4.9 Logistic regression on access to regional water schemes by migrants' demographic and socio-economic characteristics in metropolitan and non-metropolitan areas

	Metropolitan				Non-metropolitan			
	B	Wald	Sig.	Exp(B).	B	Wald	Sig.	Exp(B)
Sex								
Male	0,247	8,800	0,003	1,280	0,181	5,711	0,017	1,199
Age group		5,710	0,127			2,060	0,560	
Female@								
Children	0,115	0,011	0,916	1,122	0,937	0,842	0,359	2,551
Youth	0,209	0,810	0,368	1,233	0,221	1,338	0,247	1,247
Adults	0,013	0,003	0,954	1,013	0,177	0,910	0,340	1,193
Elderly@								
Population group		33,419	0,000			4,754	0,191	
Black/African	0,540	24,888	0,000	1,716	0,035	0,150	0,698	1,035
Coloured	0,084	0,125	0,723	1,087	-0,265	1,523	0,217	0,767
Indian/Asian	-0,265	1,267	0,260	0,767	-0,355	2,313	0,128	0,701
White@								
Level of Education		29,609	0,000			35,561	0,000	
No Schooling	0,643	8,973	0,003	1,903	0,592	12,731	0,000	1,808
Primary Schooling	0,754	23,344	0,000	2,126	0,666	22,443	0,000	1,946
Secondary Schooling	0,198	3,272	0,070	1,219	0,164	2,252	0,133	1,178
Tertiary level@								
Income group		61,585	0,000			62,397	0,000	
No Income	0,860	35,429	0,000	2,363	0,428	10,267	0,001	1,535
Lower Income	0,813	57,688	0,000	2,255	0,699	60,724	0,000	2,012
Higher Income@								
Employment status		0,618	0,734			4,821	0,090	
Employed	0,010	0,005	0,944	1,010	0,249	4,435	0,035	1,282
Unemployed	-0,103	0,396	0,529	0,902	0,076	0,274	0,601	1,079
Not economically active@								
Duration of residence		0,790	0,674			1,624	0,444	
2001-2004	0,096	0,744	0,388	1,100	-0,127	1,420	0,233	0,881
2005-2008	0,042	0,231	0,631	1,043	0,009	0,013	0,910	1,009
2009-2011@								
Province of usual residence		26,014	0,002			56,661	0,000	
Western Cape	-0,843	7,312	0,007	0,430	-0,566	3,913	0,048	0,568
Eastern Cape	-0,169	0,279	0,598	0,845	0,367	1,898	0,168	1,443
Northern Cape	-1,424	1,807	0,179	0,241	0,180	0,283	0,594	1,198
Free State	-0,944	4,697	0,030	0,389	-0,001	0,000	0,997	0,999
KwaZulu-Natal	-0,513	2,720	0,099	0,599	0,197	0,541	0,462	1,218
North West	0,034	0,005	0,943	1,034	0,047	0,030	0,861	1,048
Gauteng	-0,487	3,108	0,078	0,614	0,040	0,023	0,879	1,041
Mpumalanga	-1,363	5,129	0,024	0,256	0,679	6,412	0,011	1,972
Limpopo	-0,118	0,147	0,701	0,889	0,352	1,759	0,185	1,422
Outside SA@								
Province of previous residence		13,774	0,131			12,183	0,203	
Western Cape	-0,400	3,511	0,061	0,671	-0,213	1,102	0,294	0,808
Eastern Cape	-0,294	2,338	0,126	0,746	-0,176	1,242	0,265	0,839
Northern Cape	-0,065	0,025	0,875	0,937	-0,233	0,771	0,380	0,792
Free State	0,274	1,142	0.285	1,315	0,285	7,316	0,007	0,563
KwaZulu-Natal	-0,210	1,276	0.259	0,811	0,259	0,672	0,412	0,879
North West	-0,473	2,085	0.149	0,623	0,149	3,840	0,050	0,717
Gauteng	-0,115	0,733	0.392	0,892	0,392	4,024	0,045	0,750
Mpumalanga	0,349	1,793	0.181	1,417	0,181	4,512	0,034	0,700
Limpopo	0,009	0,002	0.962	1,009	0,962	0,319	0,572	0,915
Outside SA@								
Constant	-3,585	89,366	0.000	0,028	0,000	50,427	0,000	0,094

Source: 10% of the 2011 Census data

4.13 Logistic regression on access to water tanks as an alternative water source across areas of residence

4.13.1 Factors contributing to access to water tanks as an alternative water source across metropolitan areas

In this study, water tanks were used to identify the factors that contribute to water source access in metropolitan areas. The omnibus test of model coefficients showed that the test was statistically significant, with $p=0.000<0.05$, indicating -2 Log likelihood. Furthermore, the Hosmer-Lemeshow test shows $p=0.961>0.05$, which confirms that the model fits the data perfectly.

The results show a statistical significance between population group and access to water from water tanks. It is evident from the findings that being a Black/African migrant decreases the likelihood of accessing water from a water tanker by 0.702 times compared to white migrants. Level of education is another contributing factor that plays a tremendous role in influencing the chances of accessing water tankers as an alternative water source among migrants residing in metropolitan areas. The results show that migrants with primary and secondary education are less likely to use water tankers as their alternative water source than migrants with tertiary education. Arguably, this is because migrants with advanced education have the means to afford these tanks (Ngum, 2011) and also, they might be more aware than those with low education levels that they need to have another supply.

The findings also show a statistical significance between water tanks and migrants' level of income. The findings show that migrants in metropolitan areas with low income tend to have 0.696 times less access to water tankers than migrants with high levels of income. This is no surprise, as it clearly shows that migrants with no or less income are more likely dependent on the public supply and cannot afford alternative water sources such as buying water tanks. Another variable which was seen to negatively affect the likelihood of using water tankers by migrants as their means of alternative water source is the duration of residence. As suggested by Nsengiyumva (2013), the time spent in an area helps migrants to familiarise themselves with the environment and get to know other water sources. The findings show a level of significance between the year 2005-2008. It is indicated that migrants during this period decreased the chances of accessing water tankers by 0.737 times than the period of 2009-2011.

The province of usual residence is also identified to be significant. The findings show a statistical significance in the Western Cape and Free State provinces. Being a migrant in the Western Cape means a 3.647 times greater likelihood of having access to water tanks as an alternative water source than being a migrant from outside South Africa. Conversely, the results show that being a migrant in the Free State province means a 0.230 decrease in the likelihood of accessing water from water tanks as their alternative water source than being a migrant from outside South Africa.

4.13.2 Factors contributing to access to water from water tanks as an alternative water source in non-metropolitan areas

Looking at non-metropolitan areas in Table 4.9, the model summary indicated -2 log likelihood, the omnibus test of model coefficients was significant at $p=0.000<0.05$, and the Hosmer-Lemeshow test was $p=0.292>0.05$, which means the model fits the data. The findings reveal that there are fewer factors contributing to access to water tanks in non-metropolitan areas compared to metropolitan areas. Nonetheless, population group is one of the factors that play an important role in using water tanks as the alternative water source in non-metropolitan areas. The findings indicate that being a Black or Indian/Asian migrant decreases the likelihood by 0.614 and 0.453 respectively of using a water tank as the alternative water source compared to a white migrant in the non-metropolitan municipality.

Another variable that has a negative impact on migrants' access to water tank is the employment status. The results show that the unemployed migrant has 0.589 times fewer chances of having water tanker as the alternative water source than an employed migrant in the non-metropolitan areas. The duration of residence was also found to be significant. This means that the migrants' duration of stay in an area contributes to the chances of having alternative water sources, particularly water tanks. The results reveal that the duration of residence from the period 2005-2008 decreased the chances of migrants' accessing water from water tanks as the alternative water source by 0.717 times than in 2009-2011. Lastly, the results also found that the province of the previous residence contributes to the likelihood of using water tanks as the alternative water source in non-metropolitan areas. The results reveal that migrants from the Eastern Cape have a 1.742 greater likelihood of using water tanks as their alternative water source than migrants from outside South Africa.

Table 4.10 Logistic regression output on access to water tanks in metropolitan and non-metropolitan areas.

	Metropolitan				Non-metropolitan			
	B	Wald	Sig.	Exp(B)	B	Wald	Sig.	Exp(B).
Sex								
Male	0.066	0.378	0.538	1.069	-0,068	0,251	0,617	0,935
Female@								
Age group		1.945	0.584			4,769	0,190	
Children	17.723	0.000	0.999	4.975	18,438	0,000	0,999	10,154
Youth	-0.446	1,938	0.164	0,640	0,548	2,463	0,117	1,729
Adults	-0.421	1.786	0.181	0.656	0,294	0,766	0,382	1,342
Elderly@								
Population group		14.097	0.003			11,492	0,009	
Black/African	-0.3547	7.135	0,008	0,702	-0,488	8,965	0,003	0,614
Coloured	0,325	0,930	0,335	1,384	-0,480	1,571	0,210	0,619
Indian/Asian	0,400	1,885	0,170	1,492	-0,792	5,569	0,018	0,453
White@								
Level of Education		7,269	0,064			8,331	0,040	
No Schooling	-0,102	0,086	0,769	0,903	0,196	0,315	0,575	1,216
Primary Schooling	-0,505	5,241	0,022	0,603	-0,035	0,016	0,899	0,966
Secondary Schooling	-0,321	5,491	0,019	0,725	-0,367	3,517	0,061	0,693
Tertiary level@								
Income group		7,442	0,024			0,672	0,715	
No Income	-0,332	2,947	0,086	0,718	-0,087	0,138	0,710	0,916
Lower Income	-0,363	7,272	0,007	0,696	0,068	0,192	0,661	1,071
Higher Income@								
Employment status		0,735	0,693			4,304	0,116	
Employed	0,118	0,417	0,518	1,126	-0,269	1,325	0,250	0,764
Unemployed	-0,031	0,020	0,888	0,970	-0,529	4,299	0,038	0,589
Not economically active@								
Duration grouped		7,340	0,025			6,591	0,037	
2001-2004	-0,130	0,759	0,384	0,878	-0,280	2,368	0,124	0,756
2005-2008	-0,305	7,330	0,007	0,737	-0,333	6,013	0,014	0,717
2009-2011@								
Province of usual residence		71,512	0,000			12,461	0,189	
Western Cape	1,294	7,918	0,005	3,647	0,478	0,645	0,422	1,612
Eastern Cape	-0,020	0,002	0,964	0,980	-0,435	0,629	0,428	0,647
Northern Cape	-0,343	0,169	0,681	0,710	-0,589	0,814	0,367	0,555
Free State	-1,471	9,882	0,002	0,230	-0,334	0,317	0,574	0,716
KwaZulu-Natal	0,457	1,086	0,297	1,580	-0,193	0,123	0,726	0,825
North West	0,662	0,649	0,420	1,939	-0,337	0,373	0,541	0,714
Gauteng	0,261	0,433	0,511	1,299	-0,075	0,019	0,890	0,928
Mpumalanga	-0,393	0,428	0,513	0,675	-0,552	1,024	0,312	0,576
Limpopo	0,418	0,823	0,364	1,519	-0,433	0,644	0,422	0,649
Outside SA@								
Province of previous residence		4,588	0,869			12,539	0,185	
Western Cape	-0,286	0,924	0,337	0,751	0,446	1,283	0,257	1,562
Eastern Cape	-0,188	0,476	0,490	0,829	0,555	3,553	0,059	1,742
Northern Cape	0,639	0,734	0,392	1,894	0,487	0,978	0,323	1,627
Free State	-0,072	0,048	0,827	0,930	0,190	0,297	0,586	1,209
KwaZulu-Natal	-0,392	2,328	0,127	0,676	0,211	0,567	0,451	1,235
North West	-0,029	0,005	0,945	0,972	0,519	2,818	0,093	1,680
Gauteng	-0,154	0,557	0,455	0,857	0,420	2,665	0,103	1,522
Mpumalanga	-0,061	0,023	0,878	0,941	0,143	0,250	0,617	1,154
Limpopo	-0,266	0,962	0,327	0,766	-0,202	0,614	0,433	0,817
Outside SA@								
Constant	4,368	64,002	0,000	78,921	3,572	29,743	0,000	35,574

Source: 10% of the 2011 Census data

4.14 Logistic regression on the reliability of water supply across areas of residence

4.14.1 Factors contributing to the reliability of water supply in metropolitan areas

The results given by the logistic regression concerning the reliability of water supply among migrants in the metropolitan areas indicate a statistical significance, with p=0.000<0.05, and the model summary indicates that the omnibus test showed that the test was statistically significant with p=0.000<0.05, indicating -2 Log likelihood. Furthermore, the Hosmer-Lemeshow test shows p=0.020>0.05, which confirms that the model fits the data.

Looking at the individual variable in Table 4.10, it is clear that age is a significant factor. The results show that being a young migrant (15-35 years) leads to an increase in the odds of having reliable water supply in metropolitan areas to 1.246 times higher than elderly migrants. The results also show a statistical significance between population group and the reliability of water supply in metropolitan areas. This means that being Black/African or Coloured living in metropolitan areas means the chance of having reliable water supply is 1.827 and 1.605 times higher respectively than for white migrants. The level of education was also found to be significant. The findings suggest that having primary, secondary, or no schooling means a greater possibility of having access to reliable water supply in metropolitan areas than migrants with tertiary education. The level of income was also found to be significant. The findings reveal that being migrants with lower income means the likelihood of having reliable water supply in metropolitan areas is 1.101 times higher than for migrants earning high income. The data indicate further that employment status was significant. Being an employed migrant living in a metropolitan area means that the chance of having a reliable water supply is 0.806 times less than for migrants who are not economically active. The duration of residence was found to be significant. The data show that being a migrant who moved between 2001-2004 and 2005-2008 means that the likelihood of having reliable water supply is 0.675 and 0.686 times less than for migrants who moved during the period of 2009-2011.

The data show further that, province of usual residence is significant. The findings suggest that a migrant who stays in the Western Cape has a 1.824 times higher chance of having a reliable water supply than migrants from outside South Africa. However, the findings show that being a migrant living in the Free State province means the likelihood of having a reliable water supply by is.400 times less than for a migrant from outside South Africa. Looking at the province of previous residence, the data show that staying in certain provinces previously

decreases the chances of having reliable water supply in the current residences. The findings show that migrants who previously resided in the Eastern Cape, KwaZulu-Natal, and Gauteng were likely to experience unreliable water supply in the provinces of current residence 0.722; 0.803; and 0.796 times less than migrants who previously stayed outside South Africa.

4.14.2 Factors contributing to the reliability of water supply in non-metropolitan areas

The main factors influencing the reliability of water supply among migrants in non-metropolitan areas were identified using the logistic regression. The model coefficients show that p=0.000, and the model summary indicates -2 Log likelihood, and Hosmer-Lemeshow test shows a p=0.708>0.05, which indicates that the model fits data.

The results confirm that population group contributes to water reliability among migrants in the non-metropolitan areas. Findings illustrate that being a Black migrant increases the likelihood to 1.411 times more than being a White migrant. Level of education was observed to be another contributing factor for migrants' access to reliable water supply in non-metropolitan areas. The findings reveal that in non-metropolitan areas, being a migrant with no schooling decreases the chances of having reliable water supply by 0.719 times compared to migrants with tertiary education. The findings further reveal that level of income contributes to the reliability of water supply in non-metropolitan areas. The findings suggest that being a migrant with no income decreases the chances of having reliable water supply by 0.791 times compared to migrants with high income. This implies that uneducated migrants are more likely to be unable to afford proper supply as they may not have paying jobs to afford the water costs (Ngum, 2011). The findings reveal that duration of residence was significant, and the results indicate further that migrants who stayed during the period from 2001-2004 and 2005-2008 decreased the likelihood of having reliable water supply by 0.720 and 0.640 times compared to the migrant who stayed during the period of 2009-2011 in non-metropolitan areas respectively.

The results show that the province of usual residence was significant and contributes to migrants' access to reliable water supply in non-metropolitan areas. The findings are that six of nine provinces were significant. The study found that migrants in the predominantly rural areas, such as Eastern Cape, Northern Cape, KwaZulu-Natal, North West, Mpumalanga, and Limpopo, have decreased chances of having reliable water supply by 0.428, 0.452, 0.386, 0.534, 0.355, and 0.529 times less than migrants from outside South Africa. This suggests that

migrants in these provinces are more likely to have unreliable water supply, as they are the provinces which are predominately rural. Lastly, another variable that was found to be a contributing factor in the reliability of water supply in non-metropolitan areas was the province of previous residence. The study reveals that migrants previously stayed in Eastern Cape and Limpopo has decreased chances of having reliable water supply than migrants from outside South Africa by 0.721 and 0.049 times less. As discussed above, these provinces include more rural areas, which tend to have unreliable water supply compared to other provinces.

Table 4.11 Logistic regression on reliability of water supply in metropolitan and non-metropolitan municipalities

	Metropolitan				Non-metropolitan			
	B	Wald	Sig.	Exp(B)	B	Wald	Sig.	Exp(B)
Sex								
Male	-0.031	0.588	0.443	0.969	0,034	0,226	0,635	1,034
Female@								
Age group		5,741	0,125			16,234	0,001	
Children	-0,307	0,226	0,634	0,736	20,711	0,000	0,999	9,058
Youth	0,220	3,853	0,050	1,246	0,169	1,058	0,304	1,184
Adults	0,149	1,865	0,172	1,161	-0,114	0,525	0,469	0,892
Elderly@								
Population group		170,221	0,000			22,381	0,000	
Black/African	0,603	162,429	0,000	1,827	0,344	18,617	0,000	1,411
Coloured	0,473	23,755	0,000	1,605	0,476	6,723	0,010	1,609
Indian/Asian	0,168	4,633	0,031	1,183	0,054	0,075	0,785	1,056
White@								
Level of Education		17,492	0,001			5,115	0,164	
No Schooling	0,305	5,214	0,022	1,357	-0,330	3,818	0,051	0,719
Primary Schooling	0,204	3,956	0,047	1,226	-0,216	2,471	0,806	0,116
Secondary Schooling	0,167	15,008	0,000	1,182	-0,070	0,626	0,429	0,933
Tertiary level@								
Income group		5,674	0,059			4,146	0,126	
No Income	-0,051	0,436	0,509	0,951	-0,234	3,608	0,058	0,791
Lower Income	0,096	3,592	0,058	1,101	-0,125	2,436	0,119	0,882
Higher Income@								
Employment status		7,222	0,027			0,755	0,685	
Employed	-0,216	7,010	0,008	0,806	-0,098	0,743	0,389	0,907
Unemployed	-0,189	3,331	0,068	0,828	-0,043	0,100	0,752	0,958
Not economically active@								
Duration grouped		96,422	0,000			40,548	0,000	
2001-2004	-0,393	53,654	0,000	0,675	-0,329	11,945	0,001	0,720
2005-2008	-0,377	77,273	0,000	0,686	-0,447	37,973	0,000	0,640
2009-2011@								
Province of usual residence		147,650	0,000			105,688	0,000	
Western Cape	0,601	8,401	0,004	1,824	0,169	0,375	0,540	1,185
Eastern Cape	0,402	3,215	0,073	1,495	-0,849	9,755	0,002	0,428
Northern Cape	0,159	0,131	0,718	1,172	-0,794	5,774	0,016	0,452
Free State	-0,917	13,506	0,000	0,400	-0,432	2,153	0,142	0,649
KwaZulu-Natal	-0,238	1,302	0,254	0,788	-0,952	12,343	0,000	0,386
North West	0,242	0,591	0,442	1,274	-0,627	5,295	0,021	0,534
Gauteng	-0,085	0,185	0,667	0,918	-0,182	0,463	0,496	0,834
Mpumalanga	-0,267	0,755	0,766	0,385	-1,035	13,806	0,000	0,355
Limpopo	0,103	0,217	0,641	1,108	-0,637	5,391	0,020	0,529
Outside SA@								
Province of previous residence		16,760	0,053			8,624	0,473	
Western Cape	-0,095	0,835	0,361	0,909	-0,061	0,107	0,744	0,941
Eastern Cape	-0,326	8,578	0,003	0,722	-0,327	3,949	0,047	0,721
Northern Cape	0,196	0,802	0,370	1,216	-0,273	1,202	0,273	0,761
Free State	-0,206	1,947	0,163	0,814	-0,140	0,528	0,467	0,869
KwaZulu-Natal	-0,220	4,824	0,028	0,803	-0,222	1,841	0,175	0,801
North West	-0,177	1,378	0,240	0,838	-0,111	0,426	0,514	0,895
Gauteng	-0,228	7,651	0,006	0,796	-0,101	0,457	0,499	0,904
Mpumalanga	-0,276	3,235	0,072	0,759	-0,167	0,925	0,336	0,846
Limpopo	-0,150	1,578	0,209	0,861	-0,338	3,885	0,049	0,713
Outside SA@								
Constant	0,760	10,731	0,001	10,731	1,238	14,560	0,000	3,448

Source: 10% of the 2011 Census data

CHAPTER 5: DISCUSSION OF THE RESULTS

5.1 Introduction

This study set out to examine the relationship between internal migration and access to drinkable water in South Africa, dividing the country into metropolitan and non-metropolitan areas. The emphasis is on how migrants' demographic, socio-economic, and migratory characteristics influence access to water for drinking. This chapter gives a discussion on the findings in Chapter 4 to give an insight as to how the questions were addressed and the hypotheses were tested through the application of research design. The discussions are organised to reveal the relationship between migration and access to drinking water.

The study suggests that migrants' access to drinkable water varies from migrant to migrant based on their characteristics and whether they live in metropolitan or non-metropolitan municipalities. The study uses the data from the 2011 Census that was requested from Statistics South Africa. The data were analysed using SPSS software version 26.

5.2 Reaffirming the problem and review of methodology

A detailed discussion of the problem of this study occurred in Chapter 1 highlighting insufficient comprehensive research regarding the relationship between migration and access to drinking water. Also noted was that there is little information on migrants' access to water concerning their demographic, socio-economic, and migratory characteristics. The study used the design and methodology drawn in Chapter 3. Fixed-term and Lifetime migration was computed to measure the magnitude and direction of migration using both the provinces of previous residence and the province of current residence. Factors determining migrants' access to drinking water were also identified.

This study was rigorously quantitative in nature and used both descriptive and inferential statistics for analysis. The study used secondary data from the 2011 Census conducted by Statistics South Africa using survey methodology. The relationship between the dependent and independent variables was examined. The independent variables consisted of socio-demographic, socio-economic, and migratory variables. On the other hand, water variables were used as dependent variables in the analysis. For the preparation of analysis, the data were conceptualised using SPSS software version 26. After conceptualising the data, the analysis was carried out using the univariate analysis to explore the data. Bivariate analysis by means

of a Chi-square test statistic was used to test the relationship between the dependent and independent variables, while multivariate analysis was used to highlight factors contributing to water access. Variables on areas of residence were re-coded to a dichotomous variable (for metropolitan and non-metropolitan areas). To measure the patterns and direction of migration, lifetime, and fixed-term migration by province was calculated.

5.3 Distribution and composition of internal migrants

Chapter 4 starts by outlining the size and composition of internal migrants from the 2011 Census. Demographic and socio-economic variables, such as population group, gender, age group, level of education, level of income, and employment status, were examined. The analysis is in line with migration selectivity theory, which claims that migration is not a homogenous practice, but differs based on individuals' characteristics (Eigelaar-Meets, 2018). The study found that the majority of migrants were Black/African and White. Coloured and Indian/Asian migrants were less likely to migrate. Previous studies explain this by looking at the migration history of South Africa, where Black people were restricted and had limited chances to migrate during the apartheid regime. However, they found themselves free to move after the abolishment of that era (Pillay, Tomlinson and Du Toit, 2006; Reed *et al.*,2012). Another explanation could be that the Black/African population is the majority in the country. With regards to gender, the findings revealed an imbalance in migration, males being more involved than females. This is consistent with the findings by Mbatha and Roodt (2014) that men are still more likely to migrate than women especially over long distances. As a result, this migration pattern has an effect of reducing the sex ratios in the sending provinces, such as Eastern Cape and Limpopo, while increasing them in the receiving provinces, particularly Gauteng and the Western Cape.

Education and skills play a huge role in shaping individuals' economic conditions. Mbatha and Roodt (2014) claim that one of South Africa's big socio-economic challenges is the high rate of unemployment resulting from a lack of skills and education. The rate is believed to be highest among the youth and rural dwellers. However, the study found that most of the migrants in 2011 were employed and earning incomes ranging from high to low, with secondary and tertiary education attainment. As suggested above, this confirms that migrants with education are more likely to be economically stable, employed and earning high incomes. Moreover,

according to Ndabeni (2014), education is one of the factors influencing the propensity of movement. This is because educated migrants have greater chances to explore.
It is also evident from the findings that migration is selective based on age. It is found that young (15-35 years), and adult (36-55 years) migrants are more involved in migration patterns than children and elderly people.

5.4 Migration flow

One of the objectives of this study was to examine the magnitude and direction of internal migration across the provinces of South Africa. To have an insight on the migration flow, fixed-term and life-time migration were examined and assessed. Therefore, the research question *"What is the magnitude and direction of internal migration across South Africa's nine provinces?"* was formulated. In attempt to answer this research question, the study formulated a research hypothesis: *"In South Africa, people are more likely to migrate from less urbanised to more urbanised provinces such as Gauteng and the Western Cape."*

It is evident from the findings that less urbanised provinces are more sending than receiving, compared to industrialised provinces such as Gauteng and the Western Cape. This means that people from non-metropolitan areas are more prone to migrate to large or industrialised cities than the other way around. This implies that there are variations in developments between these areas. Lohnert and Steinbrink (2005) state that rural and urban areas are assumed to be two separate spheres, which show diverse and sovereign dynamics of development. Since Gauteng and the Western Cape provinces are economically developed than any other province in the country, this may be the reason for this migration direction. This is because a vast number of people from other provinces are migrating to these two provinces in pursuit of economic and other services that are likely to be found in these areas. High unemployment in underdeveloped provinces might have influenced this movement (Mbatha & Roodt, 2014). Mbatha and Roodt (2014) also found that in many parts of rural provinces, like the Eastern Cape, the level of unemployment was as high as 60 percent in 2004. Social and economic development is associated with urban development (Lohnert & Steinbrink, 2005). This is the reason why migrants tend to follow a temporary and circular pattern, moving between cities and provinces in search of better opportunities (Hu, Cook, and Salazar, 2008).

Conforming with migration selectivity theory discussed in Chapter 2, the study reveals that a large number of migrants, coming from less developed to most developed provinces, are younger people and adults, with small proportions of children and elderly people. Also, it was found that males are dominant in migration patterns. This confirms the notion that migrants are likely to be younger, and more likely to be male than the general population (Kok and Aliber, 2005; Hu, Cook and Salazar, 2008; Lindostrom and Ramirez, 2010; Eigelaar-Meets, 2018). However, more women and families have also started to migrate and settle in cities in recent years (Hu, Cook, and Salazar, 2008; Nsengiyumva, 2013).

Considering the effects of this movement on access to water services, it can be assumed that the high number of migrants to Gauteng and the Western Cape exacerbates the existing problems in demands and availability of water in these provinces. However, Hu *et al.,* (2008) imply that migrants are mainly excluded from urban services, and this could also affect access to drinkable water. This, therefore, indicates that not all of the migrants benefit from urban treasures due to high demands on services in these areas. Also, local municipalities in these areas may be overwhelmed and unable to accommodate and serve the growing population.
Despite the urban-based migration as discussed above, there are other forms of movement occurring within the provinces, from deep-rural areas to small towns up to metros of that province. This is supported by Reed *et al.,* (2012), who finds that migration from smaller cities to the metropolises is also considerable. As the findings of this study show, there are small proportions of people relocating from industrialised provinces such as Gauteng and Western Cape to other provinces. This type of migration may be driven by the need for improved infrastructure and services, which other rural areas are now developing (Reed *et al.,*2012).

5.5 Migrants' access to improved water across areas of residence

Another objective of this study was to examine the migrants' access to water services based on demographic and socio-economic characteristics across areas of residence. The emphasis was on piped water, water sources, alternative water sources, and reliability of water supply.
The study first examined the situation of piped water between metropolitan and non-metropolitan municipalities of SA. The findings depict that migrants are more likely to access the improved water in metropolitan municipalities compared to non-metropolitan areas. When looking, particularly, at access to piped water inside the dwelling, migrants in metropolitan municipalities are more likely to have access than migrants in non-metropolitan areas. This is because metropolitan areas are more developed than non-metropolitan areas. Metropolitan

municipalities are more likely to benefit from the national budget for social developments, including improved water supply, than in non-metropolitan areas. The findings also show that in non-metropolitan areas access to piped water is more common outside the dwellings where people have to travel long distances to reach community stands to fetch water for domestic use. The numbers are much lower in metropolitan areas, as most households have access to water either inside the dwelling or the yard without having to travel far to reach water points.

5.5.1 Access to piped water across individual metropolitan municipalities

The findings reveal that access to improved water differs across individual metropolitan municipalities. When looking at the distribution of piped water inside the dwellings, the findings show that the City of Johannesburg and Tshwane are the metropolitan municipalities providing most piped water inside dwellings, followed by the City of Cape Town. Mangaung, Nelson Mandela, and eThekwini provide relatively small percentages of piped water inside the dwellings. This shows that metropolitan areas differ in their levels of development, with the ones located in more industrialised provinces, such as Gauteng and the Western Cape, being more highly urbanised than those located in the provinces predominantly rural such as Free State, Eastern Cape, and KwaZulu-Natal. The findings also show that metropolitans in Gauteng and the Western Cape contain large proportions of migrants who access improved water outside the dwelling units, inside the yards, and on community stands, compared to the rest of other metropolitans. Oosthuisen and Naidoo (2004) find that Gauteng, South Africa's economic powerhouse, has long been dependent on immigration to supply its labour requirements, a phenomenon deeply rooted in the province's early economic history and the development of mining and heavy industry.

5.5.2 Access to piped water by level of education across areas of residence

One of the main objectives of this study was to determine the differences and similarities in migrants' access to piped water across areas of residence based on migrants' characteristics. Therefore, the hypothesis *"Migrants' access to piped water differs by level of education"* was then formulated. Migrants' level of education was identified to be one of the determining factors of migrants' access to piped water in SA. Using a Chi-square statistical test, the study found a significant relationship between migrants' level of education and access to piped water both in metropolitan and non-metropolitan municipalities. When looking at the strength of association, Phi and Cramer's V show very weak association for both residential areas.

However, in non-metropolitan areas, Lambda test showed a strong association between the variables.

This argument was supported by Ngobeni (2014), who claims that education is one of the aspects that encourages the inclination of movement. Also, education may have an impact on access to services and opportunities in areas of destination. Migrants with secondary and tertiary education in both areas of residence are more likely to have access to water inside their dwellings, as compared to those having no education or with just primary education. This contradicts the argument by Ngum (2011) that household access to water does not differ according to the level of education of the household head, but it has an impact on willingness to pay water bills. This suggests that migrants with secondary and higher education are more likely to have skills that can enable them to have jobs and ultimately being able to pay for connection charges and water bills than those with no education. The results also show that migrants with primary education are more likely to access their piped water from the community stands outside their dwellings than those with higher education. This means that migrants with basic education are likely to travel long distances to access their piped water, as opposed to those with higher education, as they are most likely to access their piped water inside their premises.

5.5.3 Access to piped water by population group across areas of residence

This section is based on the discussion between access to piped water and population group in areas of residence. South Africa has a history of restrictions in movements and inequalities in service provision across population groups (Kok *et al.*,2005; Phago, 2009). The hypothesis: *"White migrants are more likely to have access to piped water inside the dwelling than the black population"* was formulated and confirmed by the Chi-square statistical test results which showed a significant relationship between these two variables. Phi and Cramer's V showed a very weak association between the variables.

Looking at the findings in metropolitan municipalities, the study showed that white migrants dominate the access to piped water inside the dwelling across areas of residence. This suggests that there are still variations in access to services based on ethnic groups, whites still having more access to services than any population group. Smith and Hanson (2003) support this by arguing that the apartheid legacy still exists in South Africa in the form of inequalities in access

to public services, including access to improved water. Thus, these findings came as no surprise that the white population still benefit from the political system of the past. Other studies also support this argument by tracing the inequalities that existed in the past that might still have influence on the current situation when it comes to the distribution of basic services to the public across all population groups (Posel, 2004; Hosegood *et al.* 2005).

However, the study finds that Black/African migrants are more likely to have piped water inside the yard and in community stands in both metropolitan and non-metropolitan areas. These results suggest that Black people still struggle to access services, as the majority is still accessing water from substantial distances outside the dwellings. These distances vary from 200 metres up to more than one kilometre outside the housing unit. These findings imply that Black people still suffer from the marginalisation that they experienced during the apartheid regime (Bakewell, 2009; Phago, 2009). The results confirm with those of Bond (1999), that in 1994 it was just 27% of black households that received piped water inside the dwellings, while 99% of the white population had piped water inside the dwellings.

5.5.4 Access to piped water by gender across areas of residence

The objective in this section was to examine whether access to piped water is related to the gender of migrants. The hypothesis formulated was *"Male migrants are more likely to have access to piped water than female migrants"*. In this regard, gender was found to be one of the characteristics which influence migrants' access to water across areas of residence.

In metropolitan municipalities, the findings show that migrants' male-headed households are more likely to have access to piped water than female migrants heading households in South Africa. This includes access to piped water from inside the dwelling, inside the yard, and in the community stands. However, this contradicts the findings by Osei *et al.*, (2015) that female-headed households are more likely to have access to improved water sources than their male counterparts. Nonetheless, this is controversial, as other studies claim that despite women being the primary users of water, male-headed households tend to be the ones likely to access improved water sources (Farolfi *et a.l*, 2007). According to Ngum (2011), this could be based on the fact that male-headed households are more willing and have the means to pay for improved water sources than female-headed households. This could be due to the existing poverty gap between male- and female-headed households, where males are better paid in the workplace than their female counterparts. A Chi-square statistical test confirms the existence of a significant relationship between access to piped water and gender in the metropolitan

municipalities. To measure the strength of this test, the results from Lambda and Phi and Cramer's V show a very weak association between the variables.

In non-metropolitan regions, the study also finds that male migrants are more likely to have access to piped water than their female counterparts, just as in metropolitan municipalities. This implies that women in general and female migrants, in particular, still suffer from the inequalities of the past on the basis of gender. However, a Chi-square statistical test found no significant association between the two variables. This implies that there is no significant relationship between gender and access to piped water in non-metropolitan municipalities.

According to Smith and Hanson (2003), the national government and local authorities have been unsuccessful in rectifying the historical inequalities of the country. This includes the situation where females are disadvantaged in accessing services, including improved water access. It is evident from the body of literature that women in general, Black women in particular, were disregarded in every aspect. Their movement was restricted by laws such as influx control and labour migration, where it was only men who were given a chance to migrate as workers and they were marginalised in social services as well (Posel, 2004; Hosegood, 2005; Kok *et al.*,2005).

5.5.5 Access to piped water by employment status across areas of residence

In this section, the hypothesis was formulated: "*Migrants' access to piped water is determined by employment status*." It is assumed that employed migrants have a greater chance of accessing piped water than unemployed migrants. In this regard, data analysis was performed to examine whether migrants' employment status influences accessibility to piped water. Chi-square test statistics confirmed that there is an association between the two variables in both metropolitan and non-metropolitan municipalities. The strength of association was very weak in both metropolitan and non-metropolitan areas.

Looking at access to piped water and employment status in areas of residence, particularly metropolitan and non-metropolitan areas, the study shows that employed migrants have greater chances of accessing piped water inside the dwelling than those who are unemployed or not economically active. However, the findings also reveal that unemployed migrants are most likely to access their piped water from community stands at remarkable distances from their households. Confirming these results, Ndodana (2008) argues that there is a solid link between the standard of water services and poverty in South Africa. This means that the unemployed

and economically inactive migrants are most likely to access unimproved water sources, while employed migrants, and those who can afford it, access improved water. The urban poor in the slum or informal areas are more likely to have limited or no access to piped water due to the unorganised manner of their settlements (Mahama *et al.*,2014).

5.5.6 Access to piped water by level of income across areas of residence

This study also investigates the variation of household access to piped water and migrants' level of income in metropolitan and non-metropolitan areas. The objective was to find out whether migrants' level of income influences the accessibility of piped water. The hypothesis *"Level of income influences access to piped water among migrants in their areas of destination"* was formulated. To confirm this, a Chi-square statistical test was employed to test the hypothesis. The results confirm a significant relationship between access to piped water in areas of residence and the level of income. The strength of this association was measured and found very weak in both areas of residence.

The study shows disparities in migrants' access to piped water based on their level of income. This is supported by Pillay *et al.*, (2002), who claim that South Africa's economic realities have repercussions for people's access to scarce resources, such as access to piped and improved water. It is evident from the findings that migrants with low income are more likely to access piped water from inside the yard and to community stands at a distance greater than a kilometre. However, migrants with high incomes are more likely to access piped water inside the dwellings. Those with no income are the most disadvantaged group in having access to piped water in any case. This is consistent with Smith and Hanson (2013)'s findings that household income is one of the core determinants of access to improved water and sanitation in metropolitans. This means that migrants with high levels of income can afford to pay water bills and any other water connection costs that might be involved in installing piped water inside the house as opposed to those with low or no income.

Nam and Son (2015) highlight that water bills paid monthly take up to five percent of the monthly expenditure. This is why migrants with low or no income are more likely not to have piped water inside their dwellings, and use water from community stands instead. These costs become too much for them to maintain. This suggests that access to piped water favours the rich over the average and the poor. In 2030, however, the Sustainable Development Goals

(SDG) 6 is planning to achieve global and equitable access to improved drinking water to address and tackle the inequalities around access to water (Armah *et al.*,2018). This suggests that piped water should be granted free to everyone. Locally, the South African Free Basic Water policy (FBW) was established to challenge the disparities in household water access due to income variations (Ngum, 2011).

5.5.7 Access to piped water by age across areas of residence

Age is considered to be an important feature in the study of migration and access to water (Kok and Aliber, 2005). In the context of this study, it is hypothesised that *"There is a relationship between migrants' age and access to piped water across areas of residence"*. The results from a Chi-square statistical test indicate that there is an association between migrants' age and access to piped water in areas of residence. Lambda, Phi and Cramer's V were used to measure the strength of this association. The results confirm a very weak association in both areas of residence.

The results reveal that youth and adult migrants are more likely to access piped water inside the dwelling than children and elderly migrants. This can be explained by economic factors and the headship of the household. Young people and adult migrants are participating more in the labour market, meaning they can afford water inside their houses. On the other hand, children and elderly migrants are more likely to be under the guidance of the head of the house who is responsible for the household expenses. However, this contradicts the findings by Osei *et al.,* (2015), that older household heads are more likely to have access to improved water sources than the younger cohort (including the youth).

5.5.8 Access to piped water and duration of residence across areas of residence

Duration of residence is an important factor in migration literature, as it not only shows how long migrants have been staying in a particular area, but also people get to know the area better, depending on the length of their stay. In the context of this study, the objective was to see whether or not that the duration of stay has an impact on migrants' access to piped water. The hypothesis "*The longer the duration of stay, the greater the chance to access improved water"* was formulated. The hypothesis was tested using a Chi-square statistical test, which showed a significant relationship between duration of residence and access to piped water in areas of residence. The results from Lambda confirms a very strong association between duration of

residence and piped water in metropolitan areas. However, the findings in non-metropolitan areas showed a very weak association.

The study showed that from the period 2001-2004, migrants were most likely to access piped water from community stands at a distance between 200m-500m. In 2005-2008 the distance increased and the majority of migrants travelled distances greater than a kilometre to access water, and in 2009-2011 most of the migrants did not have access to piped water. This indicates drastic changes over the years in South Africa due to water scarcity caused by different factors such as droughts and climate change. This contradicts Nsengiyumva's (2013) notion that the longer the migrants' stay, the better chances to have better access to services. Similarly, Smith and Hanson (2003), in their study about access to water for urban poor in Cape Town, find that households with piped water is also associated with more years of township residence.

5.6 Migrants' access to water sources across areas of residence

5.6.1 Water sources by level of education across areas of residence

As indicated previously, the level of education is among the core factors that influence a household's water sources. To identify whether access to water sources varies by migrants' level of education, a hypothesis was proposed: *"Migrants' level of education determines the accessibility of water sources*." This hypothesis was supported by the findings of Chi-square statistics, which confirmed a significant relationship between these two variables in areas of residence. The findings show further that migrants who have had secondary or tertiary education have higher chances of having access to different water sources. This implies that the heads of households with better education have better chances of accessing water sources than those with less or no education. Tortajada and Biswas (2018) also find that household heads with higher education are more likely to have access to improved water sources than household heads with no education.

5.6.2 Water sources by population group across areas of residence

Inequalities in service delivery in South Africa are rooted in the apartheid system. South Africa is one of the most natural water-scarce regions in the world, yet Afrikaaners, the white minority, were able to enjoy green lawns and swimming pools while black Africans were deprived of a basic necessity as a reinforcement mechanism for the country's white supremacy (Creeley, 2020). In this section, the study attempts at examining the relationship between

access to water sources and the migrants' population group. In this regard, the research hypothesis *"Migrants' population group determines the accessibility to water sources in areas of residence"* was formulated and a Chi-square test statistic confirmed a significant relationship in both areas of residence. This suggests that migrants' exposure and access to water sources is determined by population group. The study measured the strength of association and found a very weak relationship between these variables. The study found that white and Black/African population groups are more likely to have access to water sources compared to other population groups in South Africa. The results show that Coloured and Indian/Asian population groups lack access to water services. Smith and Hanson (2013) also find that the growing proportion of households in low-income Coloured communities lack enough income to retain access to important services, such as water sources.

5.6.3 Water sources by gender across areas of residence

In this section, the purpose is to examine the relationship between the gender of migrants and the source of water. In this regard, a hypothesis was formulated: *"There is an association between water source and gender of migrants across areas of residence."* Using a Chi-square test statistic, the study found an association between these two variables in both metropolitan and non-metropolitan areas. Phi and Cramer's V results show a very weak association between access to water sources and gender in metropolitan areas. However, in non-metropolitan areas the results confirmed a very strong association.

The findings are that male-headed households, in both metropolitan and non-metropolitan municipalities, are more likely to have access to improved water sources such as regional water schemes provided by local municipalities than their female counterparts. Also, the findings in metropolitan municipalities show that female-headed households are most likely to access their water from open sources such as rivers, streams, and stagnant water sources. This implies that female migrants are at a high risk of using water sources that are risky and vulnerable to diseases, as they are exposed to waterborne bacteria. In addition, previous research show that black households and female-headed households remained relatively worse off in terms of access to public assets and services in 2008 compared to other population groups and male-headed households (Deghaye and Mckenzie, 2012).

5.6.4 Water sources by employment status across areas of residence

The study cross-tabulated migrants' employment status and water sources to see whether employment status determines the accessibility of water in different water sources. This study assumes that "*There is a relationship between access to water sources and employment status".* The results from the Chi-square statistical test confirm the association between employment status and access to water sources. The findings showed significant relationship across metropolitan and non-metropolitan municipalities. The findings from Lambda, Phi and Cramer's V show a very weak association between the observed variables.

The results reveal that employed migrants, both in metropolitan and non-metropolitan municipalities, have more chances of accessing water from improved water sources than migrants who are unemployed and those who are not economically active. The reason might be that employed migrants tend to stay in areas where service delivery is efficient and water sources are safe for the residents.

The study discovers, however, that migrants residing in metropolitan areas who are unemployed and those who are not economically active, tend to use water from unimproved water sources such as rivers and unprotected springs. As suggested by Tortajada and Biswas (2018), poor households face many problems such as lack of access to improved water sources. They also discovered that financial limitations make it difficult to increase supply capacity beyond the basic minimum provision subsidised by the local government.

5.6.5 Water sources by level of income across areas of residence

To examine the relationship between access to water sources and migrants' level of income, the study cross-tabulated the two variables. The level of income was categorised into three components; namely, high income; low income; and no income. The research hypothesis formulated was "*There is a significant relationship between access to water sources and the level of income*". Hence, a research question was formulated: "Is there a significant relationship between migrants' access to water sources as per their level of income?". To test the hypothesis and answer the research question, a Chi-square test statistic was performed and it showed an association between access to a source of water and migrants' level of income across areas of residence. The strength of this association was measured in areas of residence and confirmed a very weak association.

The findings reveal that access to water sources varies by migrants' level of income. Migrants with high incomes are more likely to access their water from regional water schemes, borehole, and in springs, both in metropolitan and non-metropolitan municipalities. These findings are supported by Mulenga *et al.,* (2017) who state that wealthier households are more likely to have access to improved water sources than the poor. Even though low-earning migrants also have access to these water sources, they are more likely to access their water from open sources such as dams and rivers across areas of residence.

However, looking at migrants with low income, the study confirms that these migrants in metropolitan municipalities are most likely to access their water from a rainwater tank and in stagnant water such as dams and pools. Surprisingly, the findings show that these migrants are likely to buy their water from water vendors. Given that they do not have income, one can assume that they use governmental grants or other support. Nonetheless, in non-metropolitan municipalities, migrants without income are most likely to access their water from open spaces such as rivers, and also in stored water such as water tankers and rain-water tanks.

5.6.6 Water sources by age across areas of residence

The objective of this section was to examine the relationship between migrants' age group and access to water sources across areas of residence. This was to identify which age group of migrants is more likely to access water from improved water sources. The hypothesis in this regard was formulated to see if there is a relationship between the source of water and the age group. Using a Chi-square test statistic, the study indicates that there is an association between both variables. This implies that the age group is one of the determinants of water source among migrants. The results from Lambda, Phi and Cramer's V results confirm a very weak association between the variables.

The findings showed that water sources vary based on age groups across areas of residences. Looking at elderly people, the study reveals that elderly migrants both in metropolitan and non-metropolitan municipalities are more likely to access their water from springs; buy from water vendors; and access their water from local water schemes provided by local authorities. This is perhaps because elderly people cannot afford to travel distances to fetch water and these water sources are favourable to them as it is drinkable water.

5.6.7 Water source and duration of residence across areas of residence

The duration of stay is a crucial feature in migration studies. Research has shown that migrants' duration of stay in a particular area helps to observe the surroundings and gain experience with what is happening, and particularly where to get safe water for household consumption.
To examine this, a hypothesis in this regard was formulated and tested using a Chi-square test statistic to measure the relationship between water source and duration of residence. The study found no significant relationship between the two variables for both metropolitan and non-metropolitan areas. This means that the water source is not necessarily determined by the duration of stay.

In metropolitan areas, the study showed that during the period from 2001 up to 2011, migrants were more likely to use rainwater tankers, spring water, and stagnant water such as dams and pools. This is consistent in non-metropolitan areas. This was supported by Ramulongo, *et al.*, (2017) who found that from 2001 to 2011, Makhado municipality in Limpopo experienced an increase in the number of households without access to piped water.

5.7 Alternative water source across areas of residence

5.7.1 Alternative water sources by level of education across areas of residence

The level of education is an important factor that contributes to migrants in obtaining other alternative water sources in metropolitan municipalities. According to Ngum (2011) and Dams (2018), education is a crucial variable associated with the way migrants obtain alternative sources of water for drinking and other household use.
The objective of this section is to examine whether the level of education contributes to migrants' access to alternative water sources. In this regard, the research hypothesis was formulated: *"There is a significant relationship between migrants' level of education and alternative water sources."* To test this hypothesis, a Chi-square test statistic was utilised to examine the association between migrants' level of education and access to alternative water sources in metropolitan municipalities. Conversely, the test showed no significant relationship in non-metropolitan municipalities.

Looking at metropolitan municipalities, the results showed that migrants with secondary and tertiary education are most likely to have alternative water sources compared to those with

primary or no education. This implies that migrants with primary or no education are likely to depend on one primary source, which in most cases are community taps provided by the local municipalities. The reason might be that these migrants are most likely to settle in informal settlements, where there is lack of service delivery, because of their financial situations (Smith and Hanson, 2013).

With regards to the situation in non-metropolitan municipalities, however, the findings show that migrants with primary education are more likely to have alternative water sources from unprotected and open water sources, whereas migrants with higher education are likely to have alternative water sources from improved water sources. This might be due to the level of awareness of the dangers of using unclean water and the affordability of clean water.

5.7.2 *Alternative water sources by population group* across areas of residence

One of the objectives of the study was to identify whether there is a relationship between access to alternative water sources and population group. Hence the hypothesis "*There is a relationship between migrants' population group and access to alternative water sources"* was formulated. To test this, the study used a Chi-square statistical test. The results showed a significant relationship between migrants' access to alternative water sources and population groups, both in metropolitan and non-metropolitan municipalities. This implies that migrants' access to alternative water sources could be influenced by their population group. However, the study used Lambda, Cramer's V and Phi to measure the strength of the association. The results showed a very weak association in both metropolitan and non-metropolitan areas.

In both residential areas, the findings showed that White and Black population groups have many alternative water sources as compared to other population groups. Looking at the use of stagnant water such as dams and pools, the study shows that white migrants in metropolitan areas were more likely to use these as their alternative water source. In non-metropolitan areas, however, only Black/African migrants used stagnant water.

5.7.3 Alternative water sources by gender across areas of residence

Although South Africa's Water Act of 1998 is a progressive policy that seeks to achieve racial and gender equity in water access, its implementation has been slow and flawed. The reallocation of rights to water resources in South Africa to promote equitable distribution across both race and gender has progressed slowly. Consequently, greater inequalities in water access characterise the South African water sector (Sinyolo *et al.*,2018). As has been mentioned

throughout this work, there is a gap between male- and female-headed households regarding access to services. In attempting to examine the relationship between migrants' alternative water source and gender, the following hypothesis was formulated: *"There is a significant relationship between migrants' access to alternative water sources and gender*." Using Chi-square test statistic, the data show no association between the two variables. Hence, it is concluded that migrants' alternative water source is not determined by gender. It is evident from the findings that in both metropolitan and non-metropolitan municipalities, male migrants are most likely to have alternative water sources in all the categories, compared to their female migrant counterparts. However, there was a remarkable number of female migrants using water-tanks and stagnant water as their alternative water source in both residential areas. In contrast, Armah *et al.*, (2018) found that female-headed households were more likely to have access to improved water sources as compared to male-headed households.

5.7.4 Alternative water sources by employment status across areas of residence

Employment is one of the most important factors which contribute to access to scarce resources. Hence, in obtaining alternative water sources, being employed is crucial. To ascertain this, a hypothesis was formulated: "*Access to other alternative water sources is influenced by employment status."* However, a Chi-square test statistic showed no association between the two variables in metropolitan or non-metropolitan areas. Meaning that, having other alternative water sources is not determined by employment status.

Despite the Chi-square results that show no significance, the findings from cross-tabulation show that employed migrants are more likely to have alternative water sources compared to unemployed and not-economically active migrants. This is no surprise, as these migrants can afford other alternatives should there be a shortage in their main water sources. Even so, the findings also showed a remarkable proportion of unemployed migrants using rainwater as their alternative water source. This is consistent with the study by Sturm *et al.*, (2009) about rainwater harvesting as an alternative water resource in rural Namibia. Rainwater tanks have proven to be the most efficient options among other alternatives, as they are affordable for those who are economically disadvantaged.

5.7.5 Alternative water by level of income across areas of residence

Level of income is another factor considered to be associated with access to other alternative water sources among migrants across areas of residence. Previous research (Bruce and Tamlyn, 2017) shows that there is a broad agreement that household income is a powerful predictor of domestic water quality. This directly links to poverty, where female-headed households tend to be the poorest and are thereby exposed to reduced water quality and/or poor sanitation. It is important to note that water poverty does not necessarily arise from poor access. The pipes and taps might be accessible, but the household cannot afford to get connected (Bruce and Tamlyn, 2017).

Hence, there is an assumption that the level of income influences migrants' access to other alternative water sources. Chi-square test statistics indicate an association between both variables. Therefore, it can be suggested that the level of income plays an important role in obtaining an alternative water source in case there is a water shortage. The findings from Lambda, Cramer's V and Phi confirm a very weak association, for both areas of residence.
The findings showed that migrants with high or low incomes are more prone to have alternative water sources than those with no income in times of water shortages. However, even though migrants with low income have alternative water sources, these are mostly unimproved water sources, such as springs, streams, and rivers. Migrants with a high level of income, on the other hand, are more likely to have alternative water from improved water sources such as water vendors, protected wells, and water tanks. This is supported by Mahama *et al.,* (2014), who posit that households with high income have access to improved alternative water sources compared to the poor. Surprisingly, the results show that the numbers of migrants with low income staying in non-metropolitan areas surpass those with high income in buying water from water vendors as their alternative water source.

Other alternative water sources are not always available. For instance, rainwater availability might be determined by the amount of precipitation. This is supported by Price *et al.,* (2019) who state that drinking water is not constant, as household decision-making over what water source to use at different times may be determined by changes in the availability of rainfall between seasons, or the contamination of wells following heavy rainfalls.

5.7.6 Alternative water source by age group across areas of residence

This section aims at examining the relationship between migrants' access to alternative water sources and age. This is to find out whether migrants' age may influence the accessibility to alternative water sources. The hypothesis formulated was: "*Migrants' age influences the accessibility of alternative water sources in areas of residence*". To test this hypothesis, the study used a Chi-square statistical test to examine the relationship between access to alternative water sources and age group. The results show no significant relationship between these variables in both areas of residence. This suggests that migrants' age does not determine the accessibility of alternative water sources.

The findings show that youth and adult migrants are the age groups who are more likely to have various alternative water sources than children and elderly migrants. This is applicable to both metropolitan and non-metropolitan municipalities, where adult and youth migrants are most likely to have alternative water sources in every category listed in this study. This is perhaps because elderly people might find it difficult to use water sources other than piped water inside the dwelling.

5.7.7 Access to alternative water sources and duration of residence across areas of residence

The main objective in this section is to find out whether there is a relationship between migrants' access to alternative water sources and the duration of residence. This triggered a research hypothesis: *"There is a relationship between access to alternative water sources and migrants' duration of stay in areas of residence"*. In this regard, Chi-square statistical test results show no association between access to alternative water sources and the age of the migrants in metropolitan areas. On the other hand, the findings show a significant relationship between the above-mentioned variables in non-metropolitan municipalities. This indicates that in metropolitan municipalities one does not necessarily need to stay in an area for a certain period to figure out what alternative water sources to use when necessary. However, in non-metropolitan municipalities the duration of stay is important for one to obtain alternative water sources to use should one's main source run out of water. The strength of association in metropolitan areas was moderate, and very strong in non-metropolitan areas.

The findings reveal that migrants have been using stagnant water, springs, water vendors, and boreholes as alternative water sources over the years. This is consistent in both metropolitan and non-metropolitan areas.

5.8 Reliability of water supply across areas of residence

5.8.1 Reliability of water supply by level of education across areas of residence

This section is about the relationship between the reliability of water supply and migrants' level of education. The objective is to determine whether the reliability of water supply relates to migrants' level of education. The research hypothesis here is: *"Level of education influences the reliability of water supply"*. To test this assumption, the study used the Chi-square statistical test to examine the relationship between the above-mentioned variables. The results show that in non-metropolitan municipalities there is no proven relationship between the reliability of water supply and migrants' level of education. Conversely, the results showed a significant relationship in metropolitan municipalities between the observed variables. This means that education is one of the factors that influence migrants' access to alternative water sources in metropolitan municipalities. Yet this is not the case in non-metropolitan municipalities.

With regards to migrants with tertiary education, the study revealed that they have access to reliable water, while those with no education have unreliable water supply in metropolitan areas. This implies that migrants with high educational attainment are more likely to access better services in metropolitan areas, including clean water. The opposite is true for migrants with little or no formal education. The possible explanation here could be that education in most cases is associated with economic factors. This means that households whose members have received higher education are most likely to be in a higher social class and can better afford water bill payments than those with less or no education. However, the study shows further that one does not need to be educated to have reliable water supply in non-metropolitan areas.

5.8.2 Reliability of water supply by migrants' population group across areas of residence

When the country's first democratically elected government came into power in 1994, it inherited substantial backlogs in public services, of which water supply is a prime example. An estimated 12 million people, close to one-third of the country's population, were without adequate access to drinking water. Control over water resources was unequally divided between the white central government and the black 'homelands', which comprised most of

rural South Africa (Batsirai, 2015). The objective of this section was to examine whether there is a relationship between the reliability of water supply and the various population groups. The hypothesis was formulated: "*There is a significant relationship between the reliability of water supply and population group"*. To test this hypothesis, the study used a Chi-square statistical test for the association, which confirms a significant relationship in metropolitan municipalities. However, the results show no significant relationship in non-metropolitan areas.

Both in metropolitan and non-metropolitan municipalities, the findings show that White and Indian/Asian migrants are more likely to have a reliable water supply, whereas Black/African and Coloured migrants do not have a reliable water supply. This suggests that Black and Coloured migrants experience more inconsistencies in water supply from local authorities, which is not always the case among White and Indian/Asian communities. This shows inequalities in the reliability of water supply among migrants based on their population groups.

5.8.3 Reliability of water supply by gender across areas of residence

The research objective in this section was to examine whether there is a relationship between migrants' gender and the reliability of water supply in areas of residence. The hypothesis formulated was: *"A relationship exists between migrants' gender and the reliability of water supply in areas of residence."* The results from the Chi-square statistical test reveal that there is no significant relationship between migrants' gender and the reliability of water supply, in metropolitan or non-metropolitan municipalities.

The findings showed that in both metropolitan and non-metropolitan municipalities, male migrants are more likely to find reliable regional/local water schemes compared to female migrants. This implies that there is a bias with regards to water provision based on gender, females being more disadvantaged than males. These findings were also supported by Sinyolo *et al.,* (2018) in their research on gender differences in water access and household welfare among smallholder irrigators in the Msinga Local Municipality of South Africa, finding that gender is a significant determinant of water reliability, and showing that men access water more frequently than women.

5.8.4 Reliability of water supply by employment status across areas of residence

The study also looked at the employment status to determine whether there is a significant relationship between migrants' employment status and the reliability of water supply. The hypothesis was formulated: "*There is a significant relationship between migrants' employment status and the reliability of water supply."* To test whether this hypothesis is valid, a Chi-square statistical test was used. The results confirm that there is a relationship between migrants' employment status and the reliability of water supply in metropolitan municipalities. However, this is not the case in non-metropolitan municipalities, as the findings show no significance between the observed variables.

In metropolitan municipalities, the findings show that employed migrants are more likely to find reliable water supplies, as compared to those who are unemployed and not economically active. Ramulongo *et al.,* (2017) support these findings that the reliability of water supply varies from one household to the other mainly due to a number of factors, such as employment, income, and gender (Ramulongo *et al.,* 2017). The findings show that unemployed and economically inactive migrants have an unreliable water supply, possibly because they cannot afford to pay for municipality bills.

5.8.5 *Reliability of water supply by level of income* across areas of residence

The objective of this section is to determine whether there is a relationship between migrants' level of income and the reliability of water supply in areas of residence. The research hypothesis was formulated: *"There is a significant relationship between migrants' level of income and the reliability of water supply in areas of residence."* To test this hypothesis, the study used Chi-square test statistics to examine the relationship between these two variables in both areas of residence. The results reveal that there is a significant relationship between migrants' level of income and the reliability of water supply in metropolitan areas. This suggests that the level of income affects the usage of alternative water sources should there be a shortage at the main sources. Conversely, this is not the case in non-metropolitan municipalities, where the results showed no relationship between the variables.

The findings showed that, in both metropolitan and non-metropolitan municipalities, migrants with low or no income tend to have unreliable water supply, while migrants with high income find it reliable. This might be because migrants with no income or with low income cannot afford to pay water bills. Hence, they become dependent on the regional supply. It can be

suggested that this unreliability of water supply in metropolitan areas is, possibly due to high population densities through the rise of urbanisation and the influx of migrants (Shan *et al.*,2015; Selemela and Ngoepe, 2018).

5.8.6 Reliability of water supply by age group across areas of residence

In this section, the objective is to examine whether migrants' age determines the reliability of the water supply. The following research hypothesis was formulated: *"There is a significant relationship between migrants' age group and the reliability of water supply across areas of residence."* This postulates that the reliability of water supply can be affected by age. A Chi-square statistical test confirms that there is a significant relationship between the reliability of water supply in areas of residence. To measure the strength of association between these variables, Lambda, Phi and Cramer's V were used. The findings revealed a very weak association in metropolitan areas, whereas the findings from Lambda showed a very strong association in non-metropolitan areas.

Looking at the results in metropolitan municipalities, the findings show that it is only elderly migrants who found water supply to be reliable, unlike in other age groups where water supply was unreliable. This implies that elderly migrants living in metropolitan municipalities are given a priority with regards to service provision including water supply than any other age group. In non-metropolitan municipalities, the findings show that adult and elderly migrants found water supply to be reliable, which is not the case for children and youth migrants. The possible reason is that younger people are more likely to settle in areas where public services are limited, such as informal or slum areas.

5.8.7 Reliability of water supply and duration of residence across areas of residence

This section aims to examine whether the migrants' duration of residence affects the reliability of water supply in areas of residence. The research hypothesis, *"There is a significant relationship between migrants' duration of residence and the reliability of water supply",* was formulated. A Chi-square statistical test confirms this hypothesis by illustrating that there is a significant relationship between the migrants' duration of residence and the reliability of water supply in both metropolitan and non-metropolitan municipalities. To measure the strength of association between these variables, Lambda, Phi and Cramer's V were used. The findings revealed a very weak association in both areas of residence.

The findings show that water supply has been reliable in metropolitan municipalities throughout the period of 2001 to 2011, as the majority of migrants found water supply to be reliable. This suggests that the local governments in metropolitan municipalities have provided water access to their population within this period. However, in non-metropolitan municipalities, most migrants have experienced an unreliable water supply between 2009 and 2011. The reason might be that the service delivery in non-metropolitan areas still not efficient due to lack of resources and corruption.

5.9 The predictors of water access across areas of residence across areas of residence

To identify the determinants of access to improved water sources among migrants and to what extent they influence access to improved water sources, the study used logistic regression analysis. Different models were used among metropolitan and non-metropolitan municipalities to describe the influence of every single independent variable on dichotomised dependent variables.

5.9.1 Factors contributing to access to piped water inside the dwelling across areas of residence

The Sustainable Development Goal 6 (SDG6) of the UN talks about ensuring access to safe and affordable water and sanitation for all by 2030. However, Abubaker (2019) argues that accomplishing this goal is controversial without concentrating on disparities between regions and populations. It is evident from the literature that the provision and availability of improved water sources, including piped water, is more likely to be in urban areas than in rural areas (Ato Armah *et al.*,2018). This inequality in terms of water access across areas is generally due to socio-economic resources distributed unevenly between areas.

5.9.1.1 Metropolitan areas

Variables that influence accessibility to piped water among migrants in metropolitan areas were identified and tested. The level of statistical significance was set at 0.05. The test was statistically significant and the data fit the model. Also, the model coefficient and Hosmer-Lemeshow tests were significant.

Gender was found to be one of the contributing factors affecting access to piped water inside migrants' dwelling in metropolitan areas. The findings suggest that being a male migrant in the metropolitan municipality means a greater likelihood of having access to piped water inside the house than for their female counterparts. This is consistent with the literature that, though there has been significant progress in South Africa concerning access to improved water, there are still remarkable disparities between genders. Males are benefiting more access than females (Ato Armah *et al.*,2018). This implies that male migrants are more likely to have running water inside their dwellings, whereas the female head of the household has less access to piped water inside the house and has to travel considerable distances to fetch water.

Age group was also identified as significant and increases the chances of accessing piped water inside the dwelling. The findings suggested that being a child, youth, or elderly migrant increases the likelihood of accessing piped water inside the house. This suggests that migrants in all age groups have increased chances of having access inside their dwellings in metropolitan areas.

Population group was also found significant and contributes to access to piped water inside the dwelling. The results suggest that being a Black/African migrant in the metropolitan area increases the chances of accessing piped water inside the premises. This may be because the post-apartheid government has implemented laws to balance the imbalances of the past, where previously disadvantaged groups were deprived of access to improved water (Hanson, 2003). The findings also show that levels of education influence the likelihood of having access to piped water inside the dwelling. It is suggested by the findings that migrants with no formal education, migrants with primary education, and migrants with secondary education have increased possibilities of having access to piped water inside their dwellings in metropolitan areas. This implies that despite migrants' level of education, migrants have equal chances of having piped water inside their dwellings in metropolitan areas.

The findings also indicate that level of income influences access to piped water inside the dwelling. The study shows that migrants with no income and those with low income have better chances of accessing piped water inside the house than migrants with high income. The reason for this might be that the government is empowering poor populations with programmes such as the Reconstruction and Development Programme (RDP) (Ngum, 2011), especially in the metropolitan areas. Conversely, this contradicts the findings by Abubakar (2019) that the wealthiest households are more likely to have piped water inside their dwellings. Also, the

findings indicate the duration of stay as one of the factors influencing access to piped water inside the dwelling. This suggests that time spent in a particular area increases the likelihood of having access to piped water inside the dwelling (Nsengiyumva, 2013).

5.9.1.2 Non-metropolitan areas

The model coefficient and Hosmer-Lemeshow tests were also significant in non-metropolitan areas. The results indicate that gender, population group, level of education, level of income, and employment status all influence the likelihood of accessing piped water inside the dwelling in non-metropolitan areas. Male migrants are observed to have increased chances of having access to piped water inside the house than female migrants. This suggests that in non-metropolitan areas, also, male migrants are more fortunate compared to females concerning the chances of having improved water, particularly piped water inside their dwellings. This implies that gender inequality in accessing services still exists in South Africa to this day.

Looking at the population group, the findings showed that being a Black/African, Coloured, and Indian migrant in non-metropolitan areas means having a greater possibility of accessing piped water inside his or her dwelling than a White migrant. In contrast, Bond (2008) claims that Whites are still benefiting more than other population groups in services, in SA, despite their numbers. The study also shows that migrants' level of education influences the likelihood of accessing piped water inside the dwelling. It is evident from the findings that migrants with no schooling, primary schooling, and secondary education have better chances of accessing piped water inside their dwellings than migrants with tertiary education. This might be because educated migrants tend to migrate away from rural areas to urban areas looking for more economic opportunities. This corresponds with Thet's (2014) findings that educated migrants are more likely to relocate to big cities with opportunities. Another possible reason is that significant achievements have already been made in areas such as access to basic water supply, and improvement in service delivery remains a priority in South Africa (Millennium Development Goal Report, 2013).

The level of income was also found to influence access to piped water inside the dwellings in non-metropolitan areas. The results show that migrants with no income and those with low income have greater chances of accessing piped water inside the dwelling in non-metropolitan areas than migrants with a high level of income. This might be due to the idea that the

government is empowering poor households and grants them free facilities such as running water, whereas those households with high incomes depend on themselves. Moreover, this is enforced by Target 7c of Millennium Development Goal, which aims to halve the number of people without sustainable access to safe water and basic sanitation, including hygiene (Weststrate *et al.,*2019). Lastly, the findings also show that employment status is significant. The results suggest that being an unemployed migrant means the likelihood of having access to piped water inside the dwelling is better than for migrants who are not economically active.

5.9.2 Factors associated with access water from regional/local water schemes across areas of residence

The study also looked at migrants' access to water from the regional/local water schemes as one of the water sources in areas of residence. The literature shows that the household's access to water sources is influenced by factors such as socio-economic, socio-demographic, and geographical aspects (Abubakar, 2019). The test statistics were significant and the test for goodness of fit indicated that the model fits the data well.

5.9.2.1 Metropolitan areas

In metropolitan areas, the findings from logistic regression analysis show that gender, population group, level of education, level of income, and the province of usual residence are significant. The findings reveal that male migrants have a better chance of accessing water from regional water schemes than their female counterparts. This shows that females are still lacking access to public amenities compared to males. Looking at the population group, the study shows that being a Black/African migrant in metropolitan areas means a better likelihood of having access to local regional water schemes than White migrants. Since the dawn of democracy in South Africa, the government tried to empower Blacks as they were previously disadvantaged in the past. Another reason could be that most white migrants might not rely on public water in the local region; rather, they might depend on other alternative and private sources, mostly water installed in the premises.

The findings show that migrants with no formal education and those with primary education have better chances of accessing water from local regional water schemes than migrants with tertiary qualifications. This is because migrants with tertiary education are more likely to have

paid jobs, which might help them to afford water installation inside their dwellings more than migrants with low education or without education at all. The study also shows that migrants with little or no income have better chances of accessing water from local regional water schemes than migrants with high income. This is one of the MDG goals: to ensure increased access to municipal water supply for the world's poor (McDonald *et al.*,2014). This means that the government is trying to help the poor to access water either for free or at a low cost, to bridge the poverty line. In addition, currently, South Africa has a policy called Free Basic Water Access. According to the South African Constitution every citizen is entitled to a certain amount of water regardless of his or her ability to pay for it (Mission, 2017).

Looking at the provinces of usual residence, the study shows that migrants in Western Cape, Free State, and Mpumalanga have fewer chances of accessing water from regional/local water schemes. However, Free State and Mpumalanga are predominantly rural areas and the supply in these areas is not efficient. Since Western Cape is one of the main areas of destination for migrants, it costs a lot to supply water to the residences.

5.9.2.2 Non-metropolitan areas

In this section, factors influencing the possibilities of accessing water from the regional/local water schemes in non-metropolitan areas are identified. The test statistic is significant and the model coefficient fits the data well. Gender is identified as significant since the findings indicate that being a male migrant in non-metropolitan areas increases the likelihood of accessing water from local regional water schemes than female migrants. This implies that gender imbalance between male and female hamper access to water in non-metropolitan areas. In contrast, a 2017 report released by the World Bank Group highlights the tenuous relationship between water and gender. Water access mirrors the gender inequalities in other realms of life, such as employment, household division of labour, exposure to and management of risk, access to services and decision-making. Women are often the main providers and managers of water in households, particularly in rural or peri-urban areas (Mia, 2018).

The level of education is also significant. The findings showed that migrants with no education and those with primary education have better chances of using regional/local water schemes as their main source of supply than migrants with tertiary education. This means that migrants with a higher level of education might not depend on regional/local water schemes for their

supply and using other sources. The findings also indicate that migrants with no income and those earning low income have better chances of accessing water from the regional/local water schemes than those with high income. The reason might be that those migrants get support from the government. Moreover, water is necessary both to sustain life and to promote advancement, and must therefore be guaranteed for all peoples. Governments have the duty to protect and promote these rights (Mission, 2017). However, the findings also show that employed and unemployed migrants have better chances of accessing water from the regional/local water schemes than migrants who are not economically active.

The province of usual residence and province of the previous residence was significant. Looking at the province of usual residence, the findings illustrate that being migrants in Western Cape and Mpumalanga decreases the chances of accessing water from the regional/local water schemes. Provinces of previous residence such as Free State, North West, Gauteng, and Mpumalanga contribute to migrants having a high chance of accessing water from regional/local water schemes.

5.9.3 Factors contributing to access to water tanks as an alternative water source across areas of residence

Research has shown that cities have generated a huge demand of water over time, and as more people move to the cities there will be economic growth that comes with the introduction of industrial manufacturing. Hence, this increases the demand for water, while water resources remain the same. There is therefore a clear need to relook at how to handle water resources and, most importantly, how to use water (Naidoo, 2018). The study also looks at the alternative water sources used by migrants in case of water shortage in the areas of destination. In this section, the study focused on the factors affecting migrants' access to water tanks as an alternative water source across areas of residence. The test for goodness of fit indicates that the model fits the data well and the test statistics are significant.

5.9.3.1 Metropolitan areas

In the context of the study, the main determinants of migrants' access to water water-tanks as their alternative water source were measured. The model coefficient suited the data well and it was significant. The study identified population group, level of education, duration of residence, and the province of usual residence to be significant. The results show that

Black/African migrants are less likely to use water-tanks as their alternative water sources in metropolitan areas than white migrants. This is because the majority of Black/African migrants are most likely to live in informal settlements in metropolitan areas, where they do not have enough space in their yards for water-tanks compared to whites. Also, water-tanks are quite costly. The majority of Black migrants cannot afford them, and are more likely to depend on water supplies from local government or use water from open spaces as their alternative water sources.

The findings also illustrate that migrants with primary or secondary education have fewer chances to use water-tanks as their alternative water source than migrants with tertiary education. The reason might be that migrants with high education are economically stable so that they can afford to buy these tanks (Ngum, 2011) and also, they might be more aware that they need to have other alternative supply than those with low education levels.

It is evident from the findings that migrants with low incomes are less likely to use water from water-tanks than migrants with high incomes. As argued previously, migrants with little or no income are more likely to depend on the public supply and not be able to afford other alternative water sources such as buying water-tanks, unlike migrants with high incomes who can afford to buy them.

5.9.3.2 Non-metropolitan areas

In non-metropolitan areas, the model coefficient fitted the data, and it was significant. The factors contributing to the access water-tanks in non-metropolitan areas were identified. Population group was identified as one of the factors contributing to access to water-tanks in non-metropolitan areas. The findings show that being Black/African or Indian/Asian migrant in non-metropolitan areas means a smaller chance of using water-tanks as an alternative water source than white migrants. This indicates the perpetuation of inequalities of the past, where whites had more access to services than any other population group. The findings also reveal that employment status plays a crucial role in accessing water from water-tanks in non-metropolitan areas. The findings suggest that unemployed migrants have less chance of using water-tanks as an alternative water source in non-metropolitan areas. This is because water-tanks are costly and not everyone can afford them. The duration of residence was also identified as significant. The findings show that migrants in non-metropolitan areas have less chance of using water-tanks as an alternative water source, depending on their duration of stay in the

area. This implies that migrants in non-metropolitan areas over the years learn to use other alternative water sources that are less costly, such as using water from streams and other open sources.

5.9.4 Factors contributing to the reliability of water supply

Providing reliable, adequate, and improved water supplies is becoming an increasing challenge for authorities, development agencies, and water sector organisations, particularly in countries with rapidly growing populations (Abubakar, 2019). The study examined the factors contributing to the reliability of water supply across areas of residence in South Africa.

5.9.4.1 Metropolitan areas

The model summary indicated that the model fits the data well and the test statistic was significant. The study finds that age is a prominent variable that can influence the reliability of water supply in metropolitan areas. The findings demonstrate that being a young migrant (15-35 years) means a greater likelihood of having a reliable water supply in metropolitan areas than elderly migrants. This is because elderly migrants rely only on pension which can only cover limited bills. Population group is also a contributing factor to the reliability of water supply in metropolitan areas. The findings show that being either a Black/African or Coloured migrant means a greater possibility of having a reliable water supply in metropolitan areas than white migrants. This may be possible because the local authorities and development agents in metropolitan areas provide for the previously disadvantaged population groups such as the Black and Coloured population. Level of education is also identified as a contributing factor to the reliability of water supply in metropolitan areas. The findings indicate that being migrants with primary, secondary, or no schooling means a greater possibility of having access to reliable water supply in metropolitan areas than migrants with tertiary education. This contradicts the existing body of literature that finds educated heads of households are more likely to have access to improved services (Ngum, 2011).

5.9.4.2 Non-metropolitan areas

Looking at the non-metropolitan level, the model coefficient and the Hosmer-Lemeshow tests were significant and fitted the data. Factors that contribute to the reliability of water supply in non-metropolitan areas were identified. The findings confirm that population group contributes to reliability of water supply among migrants in non-metropolitan areas. The outcome reveals

that being Black/African or Coloured means a greater likelihood of having reliable water supply than white migrants in non-metropolitan areas. This suggests that white migrants in non-metropolitan might be using other sources of supply, such as rainwater, which depends only on precipitation and other natural sources. The findings also show that migrants with no schooling have fewer chances of having reliable water supply in non-metropolitan areas compared to migrants with tertiary education. This implies that educated migrants in non-metropolitan areas have more advantages, as they have greater chances of having good jobs that enable them to afford reliable water supply in their houses. The findings also show that levels of income influence the reliability of water supply in non-metropolitan areas. Unexpectedly, the findings reveal that migrants without income have greater chances of having a reliable water supply than those with a high level of income in non-metropolitan areas. This might be the case because residents without income are assisted by the government specifically by putting into action the policy called Free Basic Water Access via municipalities.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

The focus of this study was on demographic aspects of migrant's access to drinkable water in South Africa. The aim was to examine the relationship between migration and access to water, specifically looking at migrants' socio-demographic and socio-economic characteristics. These consist of factors such as age, gender, population group, level of education, employment status, and level of income just to name a few. Migratory variables, such as the duration of residence, province of birth, province of the previous residence, and the province of current residence were used to examine migration patterns. Water variables such as access to piped water, access to water sources, access to alternative water sources, and the reliability of water supply were also explored. The area of residence was used to explore the differences and similarities of access to water across metropolitan and non-metropolitan municipalities. The study, however, uses secondary data requested from StatsSA (Census 2011) to reach this end. The data was analysed using SPSS statistical software version 25.

This study was carried out using univariate analysis, through descriptive statistics, to explore the distribution of the variables used in this study. To test the significance of the relationship between independent and dependent variables, bivariate analyses, such as Chi-square test statistics, Lambda, Phi, and Cramers' V are used. Furthermore, the study also uses multivariate analysis, using binary logistic regression to examine the factors contributing to migrants' access to safe drinking water in South Africa, both in metropolitan and non-metropolitan areas. Given that there is no unified theory applicable to migration and access to water, the study reviewed the existing theories such as push-pull theory, conflict theory, economic water theory, migration and selectivity theory. The study has conceptualized around these theories from the literature to build a conceptual framework, which guided this study of migration and water across metropolitan and non-metropolitan in the context of South Africa.

6.2 Magnitude and direction of migration

Looking at the migratory movements, the study strives to answer the research question, *"What is the magnitude and direction of internal migration across South Africa's nine provinces?"* to examine the magnitude and direction of migration in SA. Previous research indicates that Gauteng, while the smallest province geographically, is the second most populous after

KwaZulu-Natal and, in 2001, was home to 8.8 million people. The province is also the economic powerhouse of South Africa, accounting for around one-third of Gross Domestic Product in 2001 (Oosthuisen and Naido, 2004). This study discovered that people are moving around across the country for various reasons, with different socio-economic and demographic characteristics. Considering the theoretical perspectives discussed in the literature review chapter, this study conforms with the push-pull and selectivity theories. This is mainly because migrants have different motives and verdicts that lead them to migrate. Also, people differ based on their characteristics, such as their socio-economic and demographic factors. As indicated in the study, after the 1994 democratic elections, people who were previously restricted to migrate across the country were allowed to move around without any restrictions. However, it is apparent from the findings that people are more likely to migrate from less urbanised provinces to industrialised ones as a result of economic and social welfare inequalities between the provinces. Gauteng and the Western Cape are the provinces with the greatest influx of people than any other provinces in the country. This is because they are the most industrialised and economically healthy provinces in South Africa. Therefore, people tend to migrate to these provinces in pursuit of better opportunities and easy access to basic services. Consequently, these movements are believed to have adverse effects on service delivery, as they contribute to increased demands on the availability of the services in these areas. This includes the availability and provision of water services to the densifying population.

The results also show that there are variations in participation in migratory movements within the country as per migrants' socio-economic and demographic factors. Considering gender differences, the findings are that male migrants are more prone to migrate than their female counterparts. However, over the years, female migration in post-apartheid South Africa has increased. The findings also show a variation in economic factors, as the majority of migrants in areas of destination are employed with high incomes. It is also discovered that most migrants are young or middle-aged. This confirms the theory of migration selectivity, which claims that the majority of migrants are young and single. Moreover, most migrants in this study are educated to the secondary or tertiary levels, as opposed to those with no formal and primary education.

6.3 Access to water

The hypothesis *"There is a relationship between migrants' demographic characteristics such as age, gender, population group, and how migrants' access improved water across areas of residence"* was formulated. The study discovers that there are substantial inequalities in migrants' household access to drinking water in areas of residence. This is the case regardless of the attempts made by the government in the post-apartheid era to redress the disparities of the past in the provision of basic services, including safe drinking water. In 2001, the government established a policy Free Basic Water (FBW) that was meant to support and empower the previously disadvantaged population groups and the poor with basic services, including access to improved water. In contrast, however, it is apparent from the study that Black/African and Coloured households continue to suffer from lack of water. Water subsidies seem to serve the rich more than the poor for whom it was intended to serve. In addition, it is evident from the study that whites are still benefiting from the past. This makes the government's efforts to redress the disparities of the past questionable.

6.3.1 Water sources

Gauteng and the Western Cape generally have the highest overall access to improved water sources, such as access to piped water. However, the report from Statistics South Africa (2017) estimated 46.4 percent of households had access to piped water in their dwellings in 2016. A further 13 accessed water from communal taps, while 26.8% used water on sites. Although the most part households' access to water is progressing, 3.7 percent of families still had to bring water from streams, streams, stagnant water pools and dams, wells, and springs in 2017 (Statistics South Africa, 2017). However, there are noticeable improvements in the provision of improved water supply since 2006. According to StatsSA (2018), the number of households with access to piped water had increased since 2006, illustrating that 13.8 million people households had access to piped water in 2018 compared to 9.3 million households in 2006. Analysing metropolitan municipalities, 97.7% of households had access to piped water. This was most common in the City of Johannesburg, Cape Town, Nelson Mandela Bay, and Buffalo City. In contrast, the City of Tshwane and Mangaung recorded the lowest access amongst metropolitan municipalities (Statistics South Africa, 2018).

6.3.2 Alternative water source

In cases where water is not available in main water sources, it is always important to have a supplement. Alternative water source is any water source that is available to a household to supplement potable supply from the water distribution system (Nel et al, 2017). This study examines migrant's alternative water sources and it was assessed based on demographic and socio-economic aspects across metropolitan and non-metropolitan areas. It is evident from the study that there are inequalities and disparities in access to alternative water sources across areas, such as boreholes and water vendors. Women, both in metropolitan and non-metropolitan areas tend to use unimproved water sources as their alternatives, such as stagnant water from dams and pools. Households with employed migrant with high level of income are more likely to use improved water sources, whereas households with low or no income are likely to use unimproved water from open sources. It is evident from the study that the period at which migrants stayed in an area does not determine access to alternative water.

6.3.4 Reliability of water supply

South Africa has a population of about 60 million people, with 60 percent living in urban areas and 40 percent living in rural areas. The country has access to 77 percent of total use to surface water, 9 percent of groundwater, and 14 percent of recycled water. Nonetheless, the population's dependence on water is not equally distributed. Due to a need for water services in rural areas, close to 75 percent of all individuals are dependent upon groundwater, such as boreholes and wells. However, cities get most of their water from surface water sources (generated water from dams). Due to the increased migration and growth in urban areas is putting stress on cities' water supply. As it stands, most of the rural population lacks access to the reliable water supply.

This study examined the reliability of water supply among migrants in residential areas. This is to find out whether migrants have different experiences of the reliability of water supply based on their demographic and socio-economic characteristics. This also fits with the hypothesis *"Socio-demographic and socio-economic characteristics of migrants determine the reliability of water supply in areas of residence".* This study revealed that migrants with tertiary education experienced reliable water supply more than other migrants with less or no education. The variations were also apparent in population groups. The findings showed that White and Indian/Asian migrants had access to reliable water supply than Black/African and

Coloured migrants. Looking at gender, the results showed that female migrants experienced more unreliable water supply than their male counterparts did. As expected, employed migrants with high incomes were most likely to have access to reliable water supply than those who are unemployed and those who are not-economically active.

In summary, the study concludes that migrants living in metropolitan areas have higher chances of having piped water inside their dwellings. The study showed further that migrant's characteristics such as employment status, level of income, and level of education are key factors that help migrants to access water in metropolitan areas.

6.4 Recommendations and future research

Urbanisation and human migration in South Africa are expected to continue to be prevalent. This is due to migrants heading to cities providing more attractive economic opportunities and improved chances for access to public services relative to those available in their homelands. Migration as a social trend thus has considerable growth potential, taking people closer to services and economic opportunities. The current study has concentrated on internal migration. The following recommendations cover both internal and external fluxes of migration.

6.4.1 Policy recommendations

Given that most people are migrating from non-metropolitan municipalities to most industrialised ones in pursuit of improved social and economic aspects, it is recommended that the capacity and eligibility of the local government in these areas, particularly in Mpumalanga, Limpopo, Eastern Cape, Free State, and KwaZulu-Natal, be enhanced. Possibly, this should be done through the implementation of new developmental strategies and approaches to improve the conditions in these areas. Without sufficient investments in these less urbanised provinces, South Africa will continue to witness rural-urban migration. As shown in the findings, Gauteng and the Western Cape will continue to witness an increased inflow of people, mainly in pursuit of employment and improved services such as access to adequate and clean water, which might be problematic in predominantly rural provinces.

To alleviate this pattern of the migration flow, the government should make sure that non-metropolitan areas are characterised by strong and well-functioning public services, managed by skilled and competent management in the local governing body, and ensure that the services are well distributed in these areas to empower societies and migrants in particular.

Water-related policies should prioritise the most disadvantaged population, considering all aspects, especially female-headed households, unemployed people, and less-educated, poorer households. As shown by the findings, female migrants are most likely to access water from unimproved water sources and have to travel longer distances in fetching water. I would, therefore, suggest that the government implement policies that will empower women concerning access to safe water, as they are the primary users. Given that, by law, every citizen must have water, the government should support poor households in helping them to access clean and safe water at a low cost, or free.

Based on the South African constitution, every citizen is entitled to a certain total amount of water despite the ability of payment. However, the DWAF is ineffective at determining the amount of water people use monthly, especially in rural areas where there is a lack of tracking devices. By not monitoring water usage, it is difficult to determine when a waterline has broken and how to charge water-users when they exceed the free litres they are given a month. The installment of water meters nationwide would help account for the missing water. However, this can be disadvantageous for households with low or no incomes.

6.4.2 Future research direction

There is a room for future research in this area of migration and access to public services, particularly drinking water, in areas of destination. Even though the study mentions the need to include both inter-and intra-provincial movements for internal migration, the analysis focuses only on migration across provinces. However, it is important to use both inter and intra-provincial migration flows to detect net-migration rates at micro levels, such as at a district and local municipal level. Nonetheless, in measuring internal net-migration, using data across provinces is sufficient to give net gain or loss, but considering only those moves ignores migration flows across smaller administrative areas. In addition, this thesis uses old data of the 2011 Census instead of the 2016 Community Survey data. As indicated in Chapter 3, the reason for this is the 2016 Community Survey data lack some of the economic variables that are valuable in this study. Future research could use data from the 2021 Census.

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Appendices

Appendix 1: Measures of association on access to piped water

Appendix 1.1 Statistical tests on piped water and gender

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	30.397	0.000	0,046	0,046	1.229	-	-	-
Sig.	0.000	0.000	0,000	0,000	0.975	-	-	-

Appendix 1.2 Statistical tests on piped water and age

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	526.200	0,063	0,190	0,110	526.200	0,063	0,222	0,128
Sig.	0.000	0,000	0.000	0.000	0.000	0.000	0.000	0.000

Appendix 1.3 Statistical tests on piped water and population groups

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	1895.839	0,107	0,361	0,208	1655.290	0,143	0,529	0,305
Sig.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Appendix 1.4 Statistical tests on piped water and level of education

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	1129.093	0.000	0,278	0,161	689.979	0,005	0,341	0,197
Sig.	0.000	0.000	0.000	0.000	0.000	0,297	0.000	0.000

Appendix 1.5 Statistical tests on piped water and level of income

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	1953.254	0,126	0,366	0,259	1012.965	0,118	0,414	0,292
Sig.	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Appendix 1.6 Statistical tests on piped water and duration of residence

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	52.049	0,000	0,060	0,042	103.289	0.000	0,132	0,093
Sig.	0.000	0,827	0.000	0.000	0.000	0,000	0.000	0.000

Appendix 2: Measures of association on water sources

Appendix 2.1 Statistical tests on water source and gender

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	19.801	0,001	0,037	0,037	49.141	0.000	0,091	0,091
Sig.	0,011	0,257	0,011	0,011	0.000	0.000	0.000	0.091

Appendix 2.2 Statistical tests on water source and age

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	226.078	0,012	0,125	0,072	59.316	0,010	0,100	0,058
Sig.	0.000	0.000	0.000	0.000	0.000	0,040	0.000	0.000

Appendix 2.3 Statistical tests on water source and population group

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	271.279	0,000	0,137	0,079	223.921	0,000	0,194	0,112
Sig.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Appendix 2.4 Statistical tests on water source and level of education

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	213.395	0,000	0,121	0,070	173.765	0,000	0,171	0,099
Sig.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Appendix 2.5 Statistical tests on water source and income

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	285.509	0,027	0,140	0,099	228.565	0,000	0,196	0,139
Sig.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Appendix 2.6 Statistical tests on water source and employment status

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	41.663	0.000	0,053	0,038	72.876	0.000	0,111	0,078
Sig.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Appendix 2.7 Statistical tests on water source and duration of residence

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	13.164	-	-	-	16.644	-	-	-
Sig.	0,661	-	-	-	0,409	-	-	-

Appendix 3 Measures of association on reliability of water supply

Appendix 3.1 Statistical tests on reliability of water supply and gender

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	2.030	-	-	-	0.889	-	-	-
Sig.	0,154	-	-	-	0,346	-	-	-

Appendix 3.2 Statistical tests on reliability of water supply and age

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	67.409	0,000	0,070	0,070	42.863	0,003	0,096	0,096
Sig.	0.000	0.000	0.000	0.000	0.000	0,781	0.000	0.000

Appendix 3.3 Statistical tests on reliability of water supply and population groups

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	314.797	0,063	0,151	0,151	30.558	0,000	0,081	0,081
Sig.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Appendix 3.4 Statistical tests on reliability of water supply and level of education

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	74.616	0,000	0,074	0,074	6.307	-	-	-
Sig.	0.000	0.000	0.000	0.000	0,098	-	-	-

Appendix 3.5 Statistical tests on reliability of water supply and level of income

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	140.206	0,000	0,101	0,101	1.082	-	-	-
Sig.	0,000	0,000	0.000	0.000	0,582	-	-	-

Appendix 3.6 Statistical tests on reliability of water supply and employment status

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	15.418	0.000	0,033	0,033	0.650	-	-	-
Sig.	0.000	0.000	0.000	0.000	0,723	-	-	-

Appendix 3.7 Statistical tests on reliability of water supply and duration of residence

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	145.956	0.000	0,103	0,103	61.438	0.000	0,115	0,115
Sig.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Appendix 4 Measures of association on alternative water sources

Appendix 4.1 Statistical tests on alternative water sources and gender

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	6.573	-	-	-	15.738	0.000	0,122	0,122
Sig.	0,583	-	-	-	0,046	0.000	0,046	0,046

Appendix 4.2 Statistical tests on alternative water sources and age

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	67.409	0.000	0,070	0,070	42.863	0,003	0,096	0,096
Sig.	0.000	0.000	0.000	0.000	0.000	0,781	0.000	0.000

Appendix 4.3 Statistical tests on alternative water sources and population groups

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	314.797	0,063	0,151	0,151	30.558	0.000	0,081	0,081
Sig.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Appendix 4.4 Statistical tests on alternative water sources and level of education

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	74.616	0.000	0,074	0,074	6.307	-	-	-
Sig.	0.000	0.000	0.000	0.000	0,098	-	-	-

Appendix 4.5 Statistical tests on alternative water sources and level of income

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	52.558	0,092	0,211	0,149	40.252	0,002	0,195	0,138
Sig.	0.000	0.000	0.000	0.000	0,001	0,513	0,001	0,001

Appendix 4.6 Statistical tests on alternative water sources and employment status

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	20.603	-	-	-	22.165	-	-	-
Sig.	0,194	-	-	-	0,138	-	-	-

Appendix 4.7 Statistical tests on alternative water sources and duration of residence

	Metropolitan areas				Non-metropolitan areas			
Statistic	Chi-square	Lambda	Phi	Cramers'V	Chi-square	Lambda	Phi	Cramers'V
Value	12.731	-	-	-	30.391	0,004	0,170	0,120
Sig.	0,692	-	-	-	0,016	0,423	0,016	0,016

Appendix 5: A copy of migratory and water variables from the 2011 Census metadata

Section B: Migration

(P07_PROV_POB) _ PROVINCE OF BIRTH (@67 2)

P-07 PROVINCE OF BIRTH

In which province was *(name)* **born?**

01 = Western Cape
02 = Eastern Cape
03 = Northern Cape
04 = Free State
05 = Kwa-Zulu Natal
06 = North West
07 = Gauteng
08 = Mpumalanga
09 = Limpopo
10 = Outside South Africa
11 = Do not know

Write the appropriate code in the boxes.

Notes to users

This question was asked to everyone who was part of the household. The respondents were asked to indicate the province in which they were born. If born outside South Africa, category 10 (Outside South Africa) was used. For elderly persons, it was difficult to define the place according to the current provincial divisions. The enumerators were instructed to ask for the names of the place where the person was born and then locate that place in one of the present provinces (e.g. born in Ciskei, record 02 was used for Eastern Cape).

Universe

All persons in households and transients

Final code list

01 = Western Cape
02 = Eastern Cape
03 = Northern Cape
04 = Free State
05 = KwaZulu-Natal
06 = North West
07 = Gauteng
08 = Mpumalanga
09 = Limpopo
10 = Outside South Africa
11 = Do not know
99 = Unspecified

(P11B_PROVINCE OF PREVIOUS RESIDENCE) (@96 2)

In which province did *(name)* **live before moving to this place?**

01 = Western Cape
02 = Eastern Cape
03 = Northern Cape
04 = Free State
05 = Kwa-Zulu Natal
06 = North West
07 = Gauteng
08 = Mpumalanga
09 = Limpopo
10 = Outside South Africa
11 = Do not know

Write the appropriate code in the boxes.

Notes to users

The question refers to the province where the person has previously resided. If the person reported that the province of previous residence was outside South Africa (i.e. code 10), then P-11(c) and P-11(d) were skipped. But if the person reported categories 01-09 or 11 (do not know) as province of previous residence, then the enumerator proceeded to P-11(c) and P-11 (d).

Universe

All persons in households who moved since October 2001

Final code list

01 = Western Cape
02 = Eastern Cape
03 = Northern Cape
04 = Free State
05 = KwaZulu-Natal
06 = North West

(P10A_USUALRESPROV) (@78 2)

P-10a PROVINCE OF USUAL RESIDENCE

In which province does *(name)* **usually live?**

01 = Western Cape
02 = Eastern Cape
03 = Northern Cape
04 = Free State
05 = KwaZulu Natal
06 = North West
07 = Gauteng
08 = Mpumalanga
09 = Limpopo
10 = Outside South Africa
11 = Do not know

Write the appropriate code in the boxes

Notes to users

This question referred to the province where the person usually resides. If the person moved within the same province, the enumerator was instructed to fill in the code of the same province. If the move was from another country, then the 'Outside RSA' (code 10) was used.

Universe

All persons in households who were counted from another province rather than province of usual residence and transients

Final code list

01 = Western Cape
02 = Eastern Cape
03 = Northern Cape
04 = Free State
05 = KwaZulu-Natal
06 = North West
07 = Gauteng
08 = Mpumalanga
09 = Limpopo
10 = Outside South Africa
11 = Do not know
99 = Unspecified

Access to piped water _Derived

Description

Access to piped water will be derived based on five groupings

Universe

All households

Derivation

Access to piped water will be categorised using the following categories:

Response code and description	Derived code	Description
1 = Piped (tap) water inside dwelling/institution	1	Piped (tap) water inside dwelling/institution
2 = Piped (tap) water inside yard	2	Piped (tap) water inside yard
3 = Piped (tap) water on community stand: distance less than 200m from dwelling/institution	3	Piped (tap) water on community stand: distance less than 200m from dwelling/institution
4 = Piped (tap) water on community stand: distance between 200m and 500m from dwelling/institution	4	Piped (tap) water on community stand: distance greater than 200m from dwelling/institution
5 = Piped (tap) water on community stand: distance between 500m and 1 000m (1km) from dwelling /institution	4	Piped (tap) water on community stand: distance greater than 200m from dwelling/institution
6 = Piped (tap) water on community stand: distance greater than 1 000m (1km) from dwelling/institution	4	Piped (tap) water on community stand: distance greater than 200m from dwelling/institution
7 = No access to piped (tap) water	5	No access to piped (tap) water

Final code list

1 = Piped (tap) water inside dwelling/institution
2 = Piped (tap) water inside yard
3 = Piped (tap) water on community stand: distance less than 200m from dwelling/institution
4 = Piped (tap) water on community stand: distance greater than 200m from dwelling/institution
5 = No access to piped (tap) water

ALTERNATIVE WATER SOURCE

Question H-09b (A-type questionnaire) (@228 1)

H-09b ALTERNATIVE WATER SOURCE

What alternative water source did the household use during water supply interruption?

1 = Borehole
2 = Spring
3 = Rain water tank
4 = Dam/pool/stagnant water
5 = River/stream
6 = Water vendor
7 = Water tanker
8 = Other
0 = None

Write the appropriate code in the box.

Universe

All households that had interruptions in piped water supply that lasted longer than two days

Final code list

1 = Borehole
2 = Spring
3 = Rain water tank
4 = Dam/pool/stagnant water
5 = River/stream
6 = Water vendor
7 = Water tanker
8 = Other
0 = None
9 = Unspecified
Blank = Not applicable (Households that had no water interruptions and Collective living quarters)

H-08 SOURCE OF WATER

What is this household's MAIN source of WATER for household use?

1 = Regional/local water scheme (operated by municipality or other water services provider)
2 = Borehole
3 = Spring
4 = Rain water tank
5 = Dam/pool/stagnant water
6 = River/stream
7 = Water vendor
8 = Water tanker
9 = Other

Write the appropriate code in the box.

If 2-9, Go to H-10

(H-08) What is this institution's MAIN source of WATER for domestic use?

1 = Regional/local water scheme (operated by municipality or other water services provider)
2 = Borehole
3 = Spring
4 = Rain water tank
5 = Dam / pool / stagnant water
6 = River / stream
7 = Water vendor
8 = Water tanker
9 = Other

Write the appropriate code in the box.

Universe

All households and institutions

Final code list

1 = Regional/local water scheme (operated by municipality or other water services provider)
2 = Borehole
3 = Spring
4 = Rain water tank
5 = Dam/pool/stagnant water
6 = River/stream
7 = Water vendor
8 = Water tanker
9 = Other
99 = Unspecified
Blank = Not applicable (collective living quarters and other institutions)

H-09 RELIABILITY OF WATER SUPPLY

In the last 12 months, has this household had any interruptions in piped water supply?

1 = Yes *If 2, Go to H-10*
2 = No

Mark the appropriate circle with an X.

Universe

All households that get water from a regional or local water scheme

Final code list

1 = Yes
2 = No
9 = Unspecified
Blank = Not applicable (Households that had no water interruptions, and collective living quarters)

RELIABILITY OF WATER SUPPLY

Question H-09a (A-type questionnaire) (@ 227 1)

H-09a RELIABILITY OF WATER SUPPLY

Did any specific interruption(s) in piped water supply last longer than two days ?

1 = Yes *If 2, Go to H-10*
2 = No

Mark the appropriate circle with an X.

Universe

All households that had interruptions in piped water supply in the last 12months.

Final code list

1 = Yes
2 = No
9 = Unspecified

Appendix 6: Socio-economic and demographic variables from the 2011 Census metadata

AGE GROUPS (Recoded)

Description

This is a re-coding of the variable F02_AGE into five-year age groups from 0 to 85+.

Universe

This recoded variable is applicable to all persons in households and institutions

Derivation

For all person records, recode F02_AGE to AGE_GROUP 1 according to the table given below.

01	0–4
02	5–9
03	10–14
04	15–19
05	20–24
06	25–29
07	30–34
08	35–39
09	40–44
10	45–49
11	50–54
12	55–59
13	60–64
14	65–69
15	70–74
16	75–79
17	80–84
18	85+

(P20_EDULEVEL) (@132 2)

P-20 LEVEL OF EDUCATION

What is the highest level of education that *(name)* has completed?

98 = No schooling
00 = Grade 0
01 = Grade 1/Sub A
02 = Grade 2/Sub B
03 = Grade 3/Std 1/ABET 1 (Kha Ri Gude, SANLI)
04 = Grade 4/Std 2
05 = Grade 5/Std 3 / ABET 2
06 = Grade 6/Std 4
07 = Grade 7/Std 5 / ABET 3

If 98 or 00-07, Go to P-22

08 = Grade 8/Std 6 / Form 1
09 = Grade 9/Std 7/Form 2/ ABET 4
10 = Grade 10/Std 8/Form 3
11 = Grade 11/Std 9/Form 4
12 = Grade 12/Std 10 /Form 5

If 08-12, Go to P-23

13 = NTC I/N1/ NIC/(V) Level 2
14 = NTC II/N2/ NIC/(V) Level 3
15 = NTC III/N3/NIC/(V) Level 4
16 = N4/NTC 4
17 = N5/NTC 5
18 = N6/NTC 6
19 = Certificate with less than Grade 12 /Std 10
20 = Diploma with less than Grade 12/Std 10
21 = Certificate with Grade 12/Std 10
22 = Diploma with Grade 12/Std 10
23 = Higher Diploma
24 = Post Higher Diploma (Masters, Doctoral Diploma)
25 = Bachelors degree
26 = Bachelors degree and Post graduate diploma
27 = Honours degree
28 = Higher degree (Masters/PhD)
29 = Other

If 13-28, Go to P-21

If 29, Go to P-22

READ OUT: Diploma or certificate should have been at least six months study duration full-time (or equivalent).

Write the appropriate code in the boxes.

Note to users

This question referred to the highest level of education that the person had completed, not the level they were currently in if still studying. Therefore, a learner at school who was in Grade 12 at the time of the census should have completed Grade 11 and his/her highest level of education should have been reported as Grade 11. This may not always have been understood, and some people may thus be misclassified by a year. For a child who was currently in grade 1, code '00' was used for those who attended grade 0. Code '98' was used for those with no schooling or for children who were currently in grade 0. If the person attended literacy classes (for example: Kha Ri Gude) but did not finish (i.e. never obtained a certificate), then their highest level of education was 'no schooling'. Persons whose level of education was 'no schooling' (i.e. code 98), 'primary' (codes 00–07) or 'other' (code 29) were asked about their literacy (P-22). Those who said their level of education was high school/matric (codes 08–12), were not asked about their field of education and literacy. Only persons who said that their level of education was post-school (codes 13–28) were asked about their field of education.

South Africa has twelve years of formal schooling, starting at grade 1. In some schools there is also a prior Grade 0 or Grade R (Reception), which is the last year of pre-school. Before the introduction of the new grades, there were various systems for referring to the different school years. One system referred to the current grades 1 and 2 as sub-standards A and B, and grades 3–12 as standards 1 to 10. Another system referred to the last five years as Forms 1–5. In all systems, the twelfth year was usually referred to as the matriculation year. In most systems, the seventh year indicated the end of primary schooling. NTC stands for National Technical Certificate, and the three levels are roughly equivalent to Grades 10, 11 and 12. Enumerators were instructed that diplomas and certificates imply completion of a course of at least six months' duration of full-time study or the equivalent.

Diplomas and post-school certificates are sometimes available to those who have not completed Grade 12 (matric). Post-school education thus does not necessarily imply completion of all twelve years of formal schooling. In the publications, post-school without Grade 12 is usually grouped together with post-school with matric.

LEVEL OF EDUCATION GROUPED_P20 (DERIVED)

Description

This is a re-coding of the variable P20_Level of Education into eight groups.

Universe

This derived variable is applicable to all persons aged 5 years and older in households

Derivation

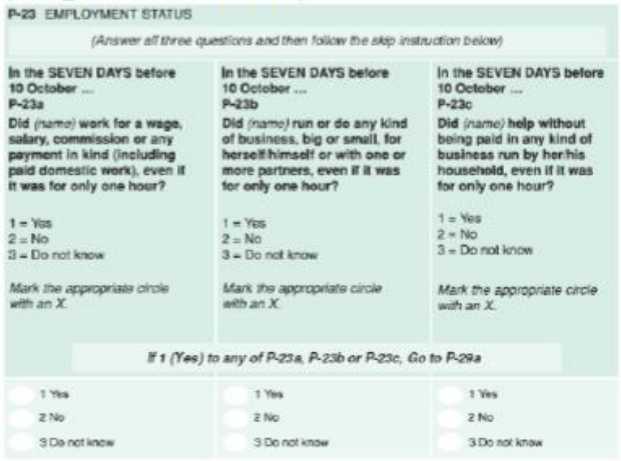
For all persons aged 5 years and older:
If P20_edulevel = 98, then assign 'No schooling = 1'
if P20_edulevel = 0:6, then assign 'Some primary = 2'
if P20_edulevel = 7, then assign 'Completed primary = 3'
if P20_edulevel = 8:11, 13, 14, 19, 20, then assign 'Some secondary = 4'
if P20_edulevel = 12, 15, then assign 'Grade 12/Std 10 = 5'
if P20_edulevel = 18 and 21:28, then assign 'Higher = 6'
if P20_edulevel = 29, then assign 'Other = 7'
if P20_edulevel = 99, then assign 'unspecified = 99'

Final codelist

1 = No schooling
2 = Some primary
3 = Completed primary
4 = Some secondary
5 = Grade 12/Std 10
6 = Higher
7 = Other
99 = Unspecified
Not applicable (children younger than five years, institutional population and transients)

Section F: Employment

(P23A_EMPLOYMENTSTATUS) (@142 1)
(P23B_EMPLOYMENTSTATUS) (@143 1)
(P23C_EMPLOYMENTSTATUS) (@144 1)



P-23 EMPLOYMENT STATUS

(Answer all three questions and then follow the skip instruction below)

In the SEVEN DAYS before 10 October ... P-23a	In the SEVEN DAYS before 10 October ... P-23b	In the SEVEN DAYS before 10 October ... P-23c
Did *(name)* **work for a wage, salary, commission or any payment in kind (including paid domestic work), even if it was for only one hour?**	**Did** *(name)* **run or do any kind of business, big or small, for herself/himself or with one or more partners, even if it was for only one hour?**	**Did** *(name)* **help without being paid in any kind of business run by her/his household, even if it was for only one hour?**
1 = Yes 2 = No 3 = Do not know	1 = Yes 2 = No 3 = Do not know	1 = Yes 2 = No 3 = Do not know
Mark the appropriate circle with an X.	*Mark the appropriate circle with an X.*	*Mark the appropriate circle with an X.*
1 Yes 2 No 3 Do not know	1 Yes 2 No 3 Do not know	1 Yes 2 No 3 Do not know

If 1 (Yes) to any of P-23a, P-23b or P-23c, Go to P-29a

Note to users

These set of questions were asked of those household members who were 15 years and older. They were asked to determine whether the person was participating in any economic activity. These questions were asked only for employment status in the last seven days, which included any activity up to the day before the reference night. Examples included a regular job, contract, casual or piece job for pay, work in exchange for grocery, housing, etc.

Commercial farms were included as businesses, but small family farms or small areas in the yard/plot that were cultivated for household food were excluded. Other examples included spaza shops, renting rooms, fetching water/ firewood for sale, stalls by roadside selling items such as sweets, chips, etc. were regarded as businesses.

Question P-23c referred to individuals who helped without pay in a businesses run by members of their usual household, not necessarily where they were being enumerated. Enumerators were advised not to count normal housework undertaken by housewives or children in the household. They were encouraged to go through the questions slowly and thoroughly and ensure that the respondent understands before answering 1 (Yes), 2 (No) or 3 (Do not know). If option 1 (Yes) was selected to any of P-23a, P-23b and P-23c, the enumerator was instructed to skip to P-29a (Industry).

(P16_INCOME) (@126 2)

P-16 INCOME CATEGORY

What is the income category that best describes the gross monthly or annual income of *(name)* **before deductions and including all sources of income?**

Monthly	Annual
01 = No income	No income
02 = R1 - R400	R1 - R4 800
03 = R401 - R800	R4 801 – R9 600
04 = R801 – R1 600	R9 601 – R19 200
05 = R1 601 – R3 200	R19 201 – R38 400
06 = R3 201 – R6 400	R38 401 – R76 800
07 = R6 401 – R12 800	R76 801 – R153 600
08 = R12 801 – R25 600	R153 601 – R307 200
09 = R25 601 – R51 200	R307 201 – R614 400
10 = R51 201 – R102 400	R614 401 – R1 228 800
11 = R102 401 – R204 800	R1 228 801 – R2 457 600
12 = R204 801 or more	R2 457 601 or more

*Gross income should include **all sources of income** e.g. Social grants, UIF, remittances, rentals, investments, sales or products, services, etc.*

Notes to users

Respondents were not required to give exact figures of their income but rather the income category/band. This was done due to the sensitive nature of the question and enumerators were advised to deal with this question cautiously. The respondents were assured of confidentiality and were told that the information was for statistical purposes only.

This question was also asked of small children, since they could have an income in the form of child maintenance grants. If the income varied during the year, the fieldworker was advised to take an average. For example, if the person worked for 6 months, the total amount for the months was divided by 12 (months) to get an average income.

Enumerators were reminded that the reference period of the annual income was 31 October 2010 to 31 September 2011. Gross income included all sources of income, for example social grants, UIF, remittances, rentals, investments, sales or products, services, etc.

(P05_POP_GROUP) (@62 1)

P-05 POPULATION GROUP

How would *(name)* **describe him/herself in terms of population group?**

1 = Black African
2 = Coloured
3 = Indian or Asian
4 = White
5 = Other

Write the appropriate code in the box.

Notes to users

This question was asked to determine the population group of all persons. Population group reflects the respondent's chosen identification and does not reflect any 'official' definition. The enumerator was instructed to ask for everybody even if the population group seemed obvious; this is because people from different population groups may form part of the same household. This question may seem sensitive to some respondents but it is really important to find out the composition of the South African population. The enumerator was instructed to accept the response given by the respondents even if the enumerator did not agree.

Universe

All persons in households, institutions and transients

Final code list

1 = Black African
2 = Coloured
3 = Indian or Asian
4 = White
5 = Other
9 = Unspecified

(F03_SEX) (@47 1)

F-03 SEX
1 = Male
2 = Female

Example

X 1 Male

2 Female

Mark the appropriate circle with an X.

Notes to users

The respondents were asked whether the *(person)* is male or female. If the person was not present at the interview, the enumerator was instructed to ask whether the person was male or female and not decide on the basis of the person's name.

Universe

All persons in households, institutions and transients

Final code list

1 = Male
2 = Female
9 = Unspecified

(P01_DOB) (@48 8)
(P01_DAY) (@48 2)
(P01_MONTH) (@50 2)
(P01_YEAR) (@52 4)

P-01 DATE OF BIRTH

What is *(name's)* **date of birth?**