

UNIVERSITY OF KWAZULU-NATAL

**THE INFLUENCE OF THE DISTANCE TO RUNNING WATER OR STANDING
WATER BODIES ON RURAL HOUSEHOLD INCOME**

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I praise you my Abba Father for being my guide even in the darkest night your teachings fill my mind. Every good thing I have is a gift from you. - Psalms 16

Abstract

Rural areas in South Africa are characterised by a lack of formal authority and inadequate basic services such as water and sanitation. As a result, deficiencies here include, but are not limited to, poor access to health facilities, inferior infrastructure and unreliable water availability. The lack of sufficient water remains a prevalent issue in these rural areas, impairing appropriate environmental, hygiene, food and personal practices.

Over large areas, the main sources of water continue to be rivers and fountains, which is used for the running of households. Water cuts through the centre of any development work within any community, and it is not unreasonable to assume that in communities where no piped water is available, living standards may be affected by the distance that household members have to cover to access water from natural sources. Yet stressing the provision of piped water has meant that research towards understanding the effects of distance to water sources has been lacking, while provision often continues to lag. A further factor to consider is the variation in income and the way human settlements are positioned in relation to water, relating to environmental and cultural factors, which vary across provinces.

This study takes a quantitative approach to identify the data sources relevant to measuring the distance from water to households, as well as income in the relevant communities. It seeks patterns in the positioning of households in relation to water and focuses on establishing if there is, in fact, a relationship between the distance of households to water bodies and income in rural South Africa. The sample included nine villages across three provinces: Eastern Cape (Ntaboduli, Mdakeni, Matshona), KwaZulu-Natal (Vongunzana, Dinsi, Sangweyana Estate) and Limpopo (India, Sekwati, Ga-mohwibidu). The distance from 30 households in each of the nine communities to their nearest standing or running water was ascertained using Google Earth™. Thereafter, with the use of census data, the average household income of each village was plotted against the distance from water in metres.

An inverse relationship matched the expectation that, as distance increases, income decreases, which can be linked to the amount of time spent collecting water. The relationship was not significant, but this is likely attributable to the small sample size and lack of income data at household scale. The researcher suggests that the more time is spent having to collect water, the less time is left available to earn a living. The research also identified some patterns in household distribution in relation to water by province and village, which are likely linked to practical, but also cultural, factors. This study recommends investing in proper water infrastructure for rural villages in South Africa.

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Abbreviations

RDP	Reconstruction and Development Programme
GEAR	Growth, Employment and Redistribution
HSRC	Human Science Research Council
ASGISA	Accelerated and Shared Growth Initiative
MDG	Millennium Development Goals
SA	South Africa
WHO	World Health Organisation
DRDLR	Department of Rural Development and Land Reform
CRDP	Comprehensive Rural Development Programme
UNICEF	United Nations International Children's Emergency Fund
UNESCO	United Nations Educational, Scientific, and Cultural Organisation
DOH	Department of Housing
KZN	KwaZulu-Natal
EC	Eastern Cape

CHAPTER ONE: INTRODUCTION

1.1 Introduction

Accessing sufficient and safe drinking water still remains an issue for rural dwellers in South Africa, as many have to walk for hours to their nearest water source. Approximately five million people's main source of water continues to be drawn from rivers and fountains, and is used for the running of households (Helba, 2012). Income is integrally linked to water as it promotes gender equality as well as health, education, housing, and the environment. Without income and the good management of water resources, access to clean water will cease to exist in South Africa (SA).

The following section discusses the motivation of the study, after which it concentrates on the dimensions that the study focused on. It then explicitly explains the problem the research aimed to solve, before stating the objectives of the study. Limitations are briefly mentioned in this chapter (these are elaborated upon in chapter 6 of this research). The structure of this research is also provided to prepare the reader for the following chapters to come.

1.2 Motivation for the study

This study will contribute to the existing body of knowledge concerning the distance to water in rural areas in the South African context. This study is intended to be useful to government and policy makers, as it will serve as a guide and baseline study to aid them with decision-making.

The need for studies of this nature is underlined by the literature reviewed, and it is ultimately hoped that this study can contribute to the understanding of the average income in rural areas and the distance to their nearest water bodies countrywide. The patterns examined here could possibly be driving wealth distribution in rural areas, without basic

water provision. Furthermore, this study aims to improve the understanding of general patterns and identify some patterns in household distribution in relation to water, which will be imperative for future research.

1.3 Focus of the study

This study did not consider all the provinces in South Africa; the research was confined to the Eastern Cape (Ntaboduli, Mdakeni, Matshona), KwaZulu-Natal (Vongunzana, Dinsi, Sangweyana Estate) and Limpopo (India, Sekwati, Ga-mohwibidu), therefore the South African population cannot be characterised as such.

This study only focused on the income aspect to water and other areas of adequate water supply might be useful to study, such as gender, education, health and environmental concerns.

1.4 Problem statement

Rural areas are characterised by a lack of formal authority and inadequate basic services such as water and sanitation. As a result, deficiencies here include, but are not limited to, poor access to health facilities, inferior infrastructure and unreliable water availability. The lack of sufficient water supply remains a prevalent issue in these rural areas, impairing appropriate environmental, hygiene, food and personal practices. Over large areas the main sources of water continue to be rivers and fountains, which is used for the running of households (Helba, 2012).

South Africa suffers from severe water shortages; the annual average rainfall in the country is approximately 464 mm in comparison to the world average of 860 mm (SAinfoReporter, 2013). Wells and boreholes are used to supply rural areas and large dams have been built over the years to foster greater access to water, however dams experience high evaporation rates. Available surface water resources are limited over most of South Africa as annual evaporation exceeds annual rainfall potential. Further perpetuating the situation is poor

groundwater resources (Maki, 2008). While access to water improved in rural South Africa between 1990 and 2010 from 66% to 79% (UNICEF, 2010), this number remains too high and no person should lack water; it is a human right and a necessity of life.

Water cuts through the centre of any development work within any community, and it is not unreasonable to assume that in communities where no piped water is available, living standards may be affected by the distance that household members have to cover to access water from natural sources. However, stressing the provision of piped water has meant that research towards understanding the effects of distance to water sources has been lacking, while provision often continues to lag. A further factor to consider is the variation in income and the way human settlements are positioned in relation to water, relating to environmental and cultural factors, which vary across provinces (Helba, 2012).

1.5 Aim and objectives of the study

Aim: To establish whether there is a relationship between the distance from households to running or standing water bodies and income in rural SA.

Objectives:

- To identify the data sources relevant for measuring the distance to water and income
- To measure the distance to water
- To look for patterns in the positioning of households in relation to water
- To extract income data
- To test for a significant relationship between the distance from water and income

1.6 Limitations

This research took the form of a desktop study, therefore secondary data were utilised for income and easily accessible data were used. The researcher could not always verify secondary data and ensure integrity, however every attempt was made to use the most reliable and recent data available. The sample was limited owing to the time constraints placed on the researcher, being a year.

1.7 Structure of chapters

This study is divided into six chapters:

Chapter 1: Introduction

Explained above.

Chapter 2: Settlement patterns in rural areas of South Africa relevant to apartheid and water access

The literature review provides an overview of the transition of water access over time and the legislative framework on water. Other aspects that are influenced by the distance of water and income are discussed, which includes, but is not limited to, gender equality, health, education, housing, and the environment.

Chapter 3: Methodology

Chapter 3 explains the quantitative research methodology used by the researcher. This method seeks to establish if a relationship exists between the two variables in order to determine if the hypothesis is accepted or rejected. Statistical tests were used to ensure a relevant relationship between variables.

Chapter 4: Results

In this chapter, the findings are presented as is the statistical analysis. The data were meaningfully processed, making it easy for the reader to interpret it.

Chapter 5: Discussion

This chapter provides a discussion on the results, which are substantiated by the literature pertaining to cultural reasoning for settlements in relation to water and income.

Chapter 6: Recommendation and conclusion

This chapter provides recommendations for future studies and highlights the most important aspects of the study.

1.8 Conclusion

This chapter introduced the research problem and went on to state the objectives, delimitations and the limitations encountered by the researcher. An outline of this work was then given. The following chapter will discuss the transition of water access and legislative frameworks of water, as well as income being an integral aspect to water as it promotes gender equality, health, education, housing, and the environment.

CHAPTER TWO: LITERATURE REVIEW

Settlement Patterns in Rural Areas of South Africa Relevant to Apartheid and Water Access

2.1 Introduction

In order to place in context the distance between households and water, a multi-disciplinary approach was needed that would be able to explain the positioning of settlements in the environment, which will ultimately result in variations in household-to-water distance values. There are a number of factors that affect settlement patterns; these include, but are not limited to, history; culture; religion; availability of land and water; market proximity; and other economic activities such as mining (Linard, Gilbert, Snow, Noor and Tatem, 2010). Nevertheless, surprisingly few studies have been undertaken placing all these factors in relation to one another, particularly in the study area of South Africa. Much of the South African literature relevant to water access is restricted to matters relating to the legacy of the apartheid system. In light of this, this literature review will advocate rural settlement patterns in South Africa in relation to apartheid and water. The apartheid legacy will be discussed and alludes to this constituting to weak earning power and inadequate water access in rural communities of South Africa.

Water access has changed over time and certain patterns observed today have their roots in pre-colonial history, but these have changed with European colonisation, apartheid, and in post-apartheid days. Access to safe drinking water is a very important human need and is consequently perceived to be a human right - a right that remains unrealised in most rural areas of SA (Van Vuuren, 2014). Notwithstanding this, it is integral for the running of households; some uses include cooking, bathing, washing of clothes, agriculture and care of livestock. This literature review will largely focus on the access to water in rural areas, while acknowledging the importance of other aspects of society affected by the lack of water supply. These include gender, health, education, housing and the environment.

Furthermore, the positioning of houses in relation to water, as shown in this dissertation, is intricately linked to all the factors mentioned above, but the positioning of entire human settlements depends on water availability as well as other factors. Consequently, factors affecting the placement of human settlements are also discussed.

A hybrid theoretical framework was used in this study to argue the responsibilities of both the government and households for the access of water. The body of knowledge included journal articles, theses, books and water policy documents, which were used to glean a better understanding of this topic.

2.2 Frameworks for understanding water access

The human right to water and the Water Commons Framework focus on the debate over water access. The former holds governments liable for the provision of water services, and it is said that water access should be at the centre of any water policy. An alternative to this is the Water Commons Framework, which some argue is individualistic and compatible with commodification. Improved water access and preservation is brought about by the framework as communities play an invaluable role in control and management, which ignites an ownership culture. Problematic hierarchies and romanticise the community scale surfaces, which only affirms that each framework has its own drawbacks (Clark, 2012).

Recently, scholars have synthesised these frameworks into a hybrid, illustrating that new possibilities are brought about by the improvement of water access where others fall short. The two abovementioned frameworks may not be as conflicting as some view them to be, but can work alongside each other (Linton, 2012). For the purpose of this study, the researcher used the hybrid framework as it was considered to be the most suitable, as it holds both the government and households responsible. It is nevertheless unclear whether an optimal solution exists.

2.2.1 The human right to water framework: the role of government in water provision

One definition of service delivery put forward by Du Toit (1999) is that of government supplying goods and services to its people, taking into account the principles of effectiveness, efficiency and economy. Officials are liable for rendering services regardless of political affiliation, and goods and services can range from education to healthcare. Supporting this approach is one definition put forward by Maki (2008), who noted that where people are unable to provide services for themselves, the government is mandated to do so. These services can occur on a national level, for example education and health, or at a local government level, which includes water services, refuse removal and the provision of electricity.

Looking more specifically at water, the government has to take concrete steps to protect and fulfil its role in rendering these services; it needs to ensure that all the relevant stakeholders realise their importance and work together for universal achievement. Municipal governments have to be held accountable for the delivery of poor services, and consistent with human rights standards, these services must be provided in a non-discriminatory and equitable manner (WHO, 2008).

The Department of Rural Development and Land Reform (DRDLR) devised a Comprehensive Rural Development Programme (CRDP), which enables rural people to play a more active role with the support of government. It was hoped that this would deal with poverty through the optimal use of natural resources (South African Yearbook, 2010/11).

2.2.2 Water Commons Framework: The role of individuals in water provision

A set of socialisation patterns are developed in communities, which are relevant not only to decision-making, but also to behaviour and attitudes towards water, hence the strong relationship between water and society. Water access, management and conservation are

dictated not only by social discipline, but also by elements of culture and religion (Clark, 2012). As these will prove to be important further on in this dissertation, definitions of these are provided here.

According to definitions as early as that of Taylor (1871), culture in its ethnographic sense can be defined as morals, arts, belief, knowledge and customs that man has adopted as members of society. The United Nations Educational, Scientific and Cultural Organisation (UNESCO) (2002) more recently defined it as a set of distinctive spiritual, intellectual and emotional feature, as well as beliefs, traditions and value systems.

Religion can be defined as the worship of a supernatural power controlling the universe, i.e. a God or Gods. The African culture believes in mystics and sangomas who bring about divine healing with the assistance of the ancestors. Ancestors are known to live in the spirit world of uNkulunkulu (the greatest of the great), and it is believed that they maintain a connection with living relatives and are therefore praised and offerings are made to them (Ashforth, 2005). African tradition further speaks of ancestors in water known as uNomkhubulwane - „Princess of Rain“. Elders perform rituals to these spirits to ensure access to water and that springs and fountains do not run dry. Consequently, religious believers did not see the need for water control mechanisms, as they believed that their faith would eradicate any water abnormalities. Other mythologies and proverbs had their roots in culture, which are taught at a very young age and carried through generations (Mistri and , Zenani, 2005).

2.2.3 Conclusion

The human right to water and the Water Commons Framework attempted to explain government's role, as well as the perceptions, behaviours and attitudes of the community with regard to culture and religion in water access. This hybrid framework enforces the need of government intervention and social discipline. The following section will discuss the factors affecting the location of settlements in rural South Africa.

2.3 Factors affecting the location of settlements

2.3.1 Characteristics of a rural settlement

It is known that many rural settlements, traditional villages and informal settlements have very little to no economic base or basic services and construction of rural houses usually includes poor quality materials that fail to comply with safety standards.. These low density areas are characterised by a depletion in natural resources such as soil, water and vegetation. Other characteristics of this social setting may include crime, domestic waste issues, poor health and social systems, unemployment, and poor infrastructure (Ahmed, Diffenbaugh and Hertel, 2009). Hardoy and Pandiella (2009) argued that informal settlements are usually unplanned, and cases of illegal developments may be causing a backlog in service delivery and poor infrastructure.

Settlement patterns in rural South Africa, as mentioned by Linard *et al.* (2010), are also confirmed by Carruthers, Krishnamani and Murray (2009), who advocated that these patterns include access to markets for the buying and selling of goods, fuel, water and other various economic and social services, including credit and banking, education and healthcare. They went on to note that the time spent by rural people on having to meet their basic needs, which many scholars synthesise as isolation, is known to be one of the main causes of poverty (Roberts, Shyam and Rastogi, 2006). A study conducted by Linard *et al.* (2010) indicated a combination of attributes found around villages during a mapping exercise. Safety, accessibility, plant species, availability of natural resources, grazing, and cultural and religious significance were all listed. The primary activities in rural areas are herding, tourism, and agriculture, which are inevitably affected by climate change as this reduces rainfall, increases temperatures and heightens water scarcity (Madzwamuse, 2010).

2.3.2 Reasons for the establishment of new villages

In order to understand the positioning of settlements in relation to water, other factors influencing this positioning also need to be discussed, starting with the very foundation of new settlements. There are many reasons for the establishment of new villages, however the most commonly cited historical reasons included drought and famine, overcrowding, constant attacks, internal conflicts, natural calamities and unproductive land (Roland, 2009).

Villages will be established in a new location if famine and drought are on the increase due to overcrowding (Johnston, Hiwasaki, Klaver and Strang, 2011), and sometimes climate in villagers' cradle land becomes unpredictable and unreliable. Shewmake (2008) supported the above view and elaborated on the importance of livestock, which is a commercial product as well as a source of food. A lack of water can cause a decline in 10% of a crop harvest caused by drought, disease and malnutrition (Dorosh, Wang, You and Schmidt, 2010). Therefore, elements of land, climate and livestock are pivotal in the establishment of new villages. Lastly, when overcrowding occurs it is mitigated by relocation, as land, water, and resources become scarce.

Hostile attacks were historically a frequent force, leading to villagers leaving their cradle land. Internal conflicts may also occur that cannot be resolved by the central administration, ruled by the king and chiefs tribe leader, hence certain clans will break away (Dorosh *et al.*, 2010). Such conflicts stem from ownership of watering areas, grazing land and agriculture. Natural disasters such as flooding are also avoided by relocation and villagers seek fertile land. Once this is found they set up establishments even if it may mean crops have to be changed (Ahmed *et al.*, 2009).

Some people are influenced to move by relatives in a quest for adventure and a better life and sometimes these villages may offer advantages of subsistence agriculture where they are able to grow their own food and be self-reliant through extensive crop cultivation and knowledge.

2.3.3 Factors influencing the location of settlements

A settlement can be broadly defined as a collection of buildings where people reside. They can vary in size from hamlets to large urban cities. The site of a settlement is known as the land that it is built upon, whilst the situation/environment is referred to as those things surrounding the settlement. For the purpose of this literature review, the situation will be discussed. The physical factors include, but are not limited to, water supply, defence and the aspect of shelter, whilst economic factors are communications and resources (NECO, 2014).

„Wet point“ sites are usually found to erect settlements upon, which refers to the need for a water supply. Depending on the conditions of the area, such as flood lines, some villages have to be built away from rivers and water supply on dry areas (NECO, 2014). Water also serves as a defence when settlements are strategically located inside meanders. Some settlements also take upon high ground to spot enemy attacks. The final aspect, shelter, relates to areas where the sun’s rays are in the west (in the Southern Hemisphere); a west facing slope shelter will be hotter than an east, unless rainfall patterns dictate otherwise (Jonathan, Baxter and Huntley, 2006).

Communication, being an economic factor, refers to bridging points whereby rivers can be easily crossed to encourage maximum communication amongst settlements. This inevitably fosters relations with surrounding villages. Other favourable locations include gaps in hills and junctions of valleys (NECO, 2014). Furthermore, economic resources such as wood used for fuel and building have to be relatively close. In this regard there are three primary settlement structures: linear, along coasts, and valleys and roads in a line. Nucleated buildings are closely grouped for defence purposes and commonly located at crossroads. Dispersed is often the choice in rural villages, whereby households are spread out (Linard *et al.*, 2010).

2.3.4 Conclusion

The above depicts patterns in rural placement in terms of reasons for establishment and factors that affect placement in rural SA. The various literature sources consulted revealed history and proximity to water as being essential determinates to establishment placement. These will be extensively discussed in relation to water access in the following sections.

2.4 The transition of water access in South Africa post-apartheid

Research suggests that the inequalities in terms of patterns of basic services in South Africa are due to the apartheid era, which caused imbalances in the population and also segregated communities based on race. Moreover, it was responsible for urban areas been developed early, known as spontaneous areas. These areas were characterised by poor service delivery, such as a lack of adequate, safe water (Adebayo, 2000). This section will discuss the transition of water access in SA alongside the development of government legislative frameworks, which include the plans, programmes, projects, and policies to overcome these backlogs.

2.4.1 Background

South Africa has emerged from the apartheid era, which had entrenched legislation that suppressed non-white citizens. An example of this is the 1913 Land Act, which forced all black citizens into infertile reserves that formed 13% of SA's territory (Browett, 1982; Walker, 2005; Lahiff, 2007). This forced a supply of cheap black labour during the 20th century boom of the industrial and mining sectors (Pretorius and du Toit-de Villiers, 2002).

To control the influx of black Africans into white neighbourhoods the government enforced racial segregation policies (Bonner, 1995). These policies stated that Africans could only enter these areas to offer labour and had to return to their stipulated reserves when not needed (Dimitrou, 1990; Maylam, 1990). Access to basic services was rendered based on

race, leaving black people on the receiving end of poor and no services at times (Smith, 2004; Smith and Green, 2005). Prospects of a better life presented itself after the official abandoning in 1991 of segregation policies (Bond, 2000). This enabled people to move across the racial divide and aimed to eradicate underdevelopment and poverty (Cheru, 2001; Ngwane, Yadavalli and Steffens, 2002). Bantustan people were able to seek jobs and amenities in urban areas. Bantustan areas can be defined as black homelands that were designated to separate land based on races during the apartheid era (Phillips, Lissoni, and Chipkin, 2014). The indefinite influx had a ripple effect on shack dwellings that lacked basic water services (CSIR, 1999).

2.4.2 Reconstruction and Development Programme (RDP)

With democracy came the hope that basic services would improve and backlogs would become non-existent (Bruggemans, 2004). Between 1994 and 1995, approximately 16 million people did not have access to water (Campbell, 2001; Pottie, 2003); evidently the government was faced with challenges in redressing the legacy apartheid had left. Through the formulation of the Reconstruction and Development Programme (RDP), government wished to address historical inequalities through a massive build-programme for the expedition of basic services (Binns and Nel, 2002; Visser, 2004). Midgley (2001) confirmed this by advocating that the RDP was the first of many policies embarked on by the South African government, which sought to redress the inequalities of post-apartheid (African National Congress, 1994). This macro policy framework was introduced to create social justice and ensure that everyone had the right to basic services (Adelzadeh, 1996; Mackay, 1999). This was further reinforced in the Constitution of the Republic of South Africa (Act 108 of 1996), which guaranteed access as well as equal service delivery to all citizens (Bruggemans, 2004).

2.4.3 Growth, Employment and Redistribution (GEAR) Strategy

Soon the government realised that the RDP would not be possible without an economic base and introduced the Growth, Employment and Redistribution (GEAR) strategy (Bruggemans, 2004). This macro policy sought to sustain economic growth and fiscal discipline whilst retaining the social objectives of the RDP (Cheru, 2001; Bond, 2000). The objective of GEAR was much in the same of the RDP, as it still captured the distribution equity (Visser, 2004). Furthermore, greater emphasis was placed on the use of private capital for investment, the cost recovery measures to service provision and economic growth (Khosa, 2000). GEAR fulfilled a dual purpose of not only providing services but ensuring fiscal disciplines were met (Smith and Green, 2005). Smith and Hanson (2003) asserted that GEAR forced municipalities to exercise fiscal discipline. More responsibilities were shifted to local municipalities in GEAR, as was not the case in the RDP, where tasks were carried out in the national and provincial spheres of government (Visser, 2004; Weeks, 1999).

Although GEAR put the economy on a growth trajectory, it was not sufficient to provide employment to reduce poverty. Citizens could no longer pay for services rendered and municipalities were unable to implement cost recovery strategies, which was essential in the provision of services (Visser, 2004). The Human Science Research Council (2002) maintained the same sentiments, saying that cost recovery strategies, a key element in GEAR, were necessary for sustainable development, however this placed further financial burdens on the poor.

2.4.4 Accelerated and Shared Growth Initiative (ASGISA)

GEAR was criticised for this and experts suggest that GEAR was the cause of the failure to build sustainable living (Goebel, 2007). Governments had to prioritise services to communities, which led to periphery of urban centres (Huchzermeyer, 2001; Goebel,

2007). This contradiction between the RDP and GEAR policy made it difficult for government to provide infrastructure for water (River Health Program, 2005) as service delivery needs changed regularly and government had to refine policies and respond appropriately (Funke *et al.*, 2007). In 2005, one of the refinements gave rise to the Accelerated and Shared Growth Initiative (ASGISA), which aimed to address deficiencies in GEAR. Yet indications show that it is failing in its duties to attain social equity in South Africa (Baty, 2009).

Despite many contradictions between RDP, GEAR and ASGISA, they all provide a framework for the equitable access of basic services. In ensuring a legal backbone, an array of policies and legislation were devised to govern water services. This is detailed in sections 2.4.5-2.5.9.

The preceding frameworks were not made in vain, however, as studies indicate that there has been an increase in the access to water, yet 5,759,862 million people still suffered from a lack of these services as at April 2008. Table 2.1 illustrates this.

Table 2.1: Population without access to potable water (DWA, 2008a)

Province	Total Water Backlog April 1994	Total Water Backlog April 2001	Total Water Backlog April 2006	Total Water Backlog April 2008	%Backlog April 2008
Eastern Cape	3,689,468	3,117,596	1,578,996	1,097,727	19.00
Free State	624,811	404,905	207,379	39,266	1.00
Gauteng	1,235,463	898,189	683,026	352,815	6.00
KwaZulu Natal	3,863,572	4,047,872	2,584,186	2,128,791	37.00

Limpopo	2,405,632	2,172,269	1,484,660	1,081,218	19.00
Mpumalanga	1,221,170	1,016,630	731,832	474,398	8.00
Northern Cape	1,030,826	909,779	612,867	381,395	7.00
North West	392,729	170,811	117,221	78,755	1.00
Western Cape	1,426,578	364,519	217,666	125,497	2.00
National	15,890,249	13,102,570	8,217,833	5,759,862	100.00

Table 2.1 shows the backlogs in water delivery for the period 1994 to 2008 per province in South Africa. The top three provinces without access to water are KwaZulu Natal (KZN), the Eastern Cape and Limpopo, with the former having 37% of the population without access to water and the latter two 19% each.

Communal taps were installed as a result of inadequate water access, which were situated outside homes away from sanitation facilities. Personal hygiene was thus compromised and this left the possibility of food contamination (River Health Program, 2005). The improvement to water facilities as a prerequisite for health, hygiene, education, housing and the natural environment can thus not be over emphasised (Choguill, 1999).

2.4.5 Free Basic Water Policy

The daunting tasks left by apartheid for the democratic government for redress meant the imposition of legislative reviews and reforms to enable government to streamline water

services (Smith and Hanson, 2003). With the establishment of the local tier of government in 1996, the provision to water services shifted from central to local government (Smith and Green, 2005). This was the ideal time as municipalities were being demarcated to include previously disadvantaged areas. (McDonald, 2002).

Water wastage was prevalent in areas where water sources were communal and standpipes were used. Communal taps were often shared amongst ten to 20 users, while individual or shared standpipes were shared amongst one or two households only. Consumption was relatively high as water was available free of charge, so no sense of ownership or a responsibility mentality evolved as consumption patterns were not a consideration (Wood, Uchronska and Valashiya, 2001).

This caused frequent damage and leaks to standpipes. In such areas, there was little waste water disposal and often water collected around standpipes which created unhygienic living conditions (van Vuuren, 2007), thus community members were unwilling to pay for services (University of Cape Town Greywater Research Team, 2005).

The government developed a Free Basic Water (FBW) policy to help with affordability for the poor, which gave a „life-line“ of 6 kilolitres (kl) of water per household for the month, with a consumption rate of 25 litres per day (DWAF, 2001; Peters and Oldfield, 2005).

Municipalities were given much lead way in the formation of this policy (Lagardien and Cousins, 2004; Smith and Green, 2005). They were allowed to use their discretion when providing free basic services to all consumers, regardless of income, whether the policy was targeted mainly at the poor or whether municipalities were going to subsidise a portion of community`s utility bills. Restrictive devices were also allowed to limit water per month, by municipalities (Hall, Leatt and Monson, 2006).

As stated earlier, under the Water Act 108 of 1997 water was allocated at 6 kl per month, which was considered to meet the health and basic needs of a household (MacKay and Ashton, 2004; Hall *et al.*, 2006). If a household exceeded this allocation, a tariff was

charged which caused financial strain on the poor once again (Ralo, Grinaker, Kruger, Steele and Weitk, 2000).

The Free Basic Water policy aimed to provide free clean drinking water to 31 million people by February 2005. Further to this, the issue of a lack of safe drinking water was scheduled to be eliminated by 2008. To date this has not being achieved (Department of Water Affairs and Forestry, 2014)

2.4.6 Millennium Development Goals

Improving accessibility to water in rural areas is essential to many of the Millennium Development Goals (MDG), which are: (i) eradicating extreme poverty and hunger by improved food security, (ii) achieving universal primary education and gender equality as children are able to go to school and the burden of fetching water is not left to females; and (iii) improving child health and maternal mortality through improved hygiene (Millennium Development Goals (MDGs), 2005).

The international decade for action and renewed effort to achieve the Millennium Development Goals (MDGs) began in 2005. The aim was to halve the population with inadequate water and sanitation services by 2015. In achieving the MDG for water, great technology, economic resources and political will is needed. This goal sets out the targets of providing 6.1 billion people with water among poor households in the poorest of countries (Moe and Rheingans, 2006). Massoud (2011) argued, however, that a lack of local expertise is leading to poor operations and restricted budgets.

2.4.7 The Constitution Act 108 of 1996

In the Constitution, water is recognised as a basic human right; this is a consequence of the perception that water is the origin of all things – the giver of life. In the same way, the Constitution states that everyone has the right to adequate safe drinking water. In attaining this it goes on to note that the state is liable for this and should make every attempt to ensure a progressive realisation.

2.4.8 Water Services Act 108 of 1997

In line with the need to ensure the realisation of the right of access to water and sanitation, the South African Parliament enacted the Water Services Act 108 of 1997. The preamble to the Act identifies the human right to water that is not harmful to a person's health or the environment. Again, it notes government's role in achieving this.

2.4.9 The Bill of Rights

The Bill of Rights acknowledges the duty of government to promote access to sufficient water and suggests the involvement of informational and educational programmes, however the obligation of fulfilment is not being met in many rural areas. In this context, the lack of water impedes the delivery of other human rights, which include health and sanitation, which is provided for in the Constitution.

2.4.10 Water in South Africa today

International success in the improvement of health systems through water encouraged the South African democratic government to prioritise such services in the quest for poverty reduction (UNDP, 2006). In 2001, 57.6% of the population had access, whilst 42.4% remained without (StatsSA, 2001). The years 2001-2008 showed significant progress, with access improving to 73% and backlogs reducing to 27% (DWAF, 2008). The Strategic Framework for Water Services forced all spheres of government in 2003 to mobilise funds towards water and sanitation infrastructure delivery.

Between 1990 and 2010, the country had some success with increased access to water in rural communities. An increase of 66% to 79% was achieved, and while this is rather slow progress, this is attributable to communities not necessarily prioritising water above other needs (WRC, 2009).

Ninety countries came together to form the United Nations International Children's Emergency Fund (UNICEF), where the prime goal was to improve water supply and sanitation facilities in communities and schools. All programmes were designed to meet the MDG of halving the number of people without safe drinking water by 2015 (Naidoo, 2014). The United Nations (UN) reported success from its Wash programmes, with 1.6 million gaining access to safe drinking water. In developing countries, rural areas are the most hard hit and Africa is a recipient of such programmes (UNICEF, 2007).

2.4.10.1 Government reports on water

The State of the Nation Address is an annual event in the Republic of South Africa, in which reports are given by the President on the status of the nation. Key issues are outlined and addressed to the public and this notes the opening of the parliamentary year.

Concerning water in 2011, the government set out to spend approximately R2.5 billion, which was largely focused on the priority areas of the Eastern Cape, KwaZulu Natal and Limpopo. Although it was reported that year that 400,000 more houses were supplied with water in comparison to 2009, the 2012 State of the Nation Address noted a delay in water expansion. Success was achieved in 2012 with nine out of ten households having access to water. A project was also embarked upon in October 2012 to create a distribution system for De Hoop Dam, which provides water for the population of Sekhukhune (The State of the Nation Address, 2011; 2012; 2013).

The National Budget speech is a formal presentation made in the national house by the Minister of Finance, where he introduces the government's plans concerning fiscal, economic and social policy (the Budget). Aligning with the plans set out in the State of the Nation Address, Minister Pravin Gordhan allocated R132 billion for water in 2013, and of this R4.3 billion was expected to be used solely for water in rural communities (Budget Speech, 2013).

2.5 Rural water access in South Africa

2.5.1 The relevance of water in rural communities

Water is vital for sustaining all sectors pertaining to social and economic development. Fresh water is a necessary input for hydropower generation, industry, mining, subsistence and commercial agriculture, tourism, livestock production, and fisheries. These activities create employment and contribute to national economies through export earnings, amongst other things. Moreover, they can be seen to be central to human well-being and livelihoods, and cannot be overlooked (Bimo, 2014). Massoud (2011) concurred, saying that water is used for various purposes including agricultural irrigation, municipal and industrial supply, waste assimilation, hydroelectric power generation and recreation. The availability of water in surplus as well as adequate quality is essential for sustainable development, as it has a leading role to play in all sectors of development.

Water is also an integral component of public health and the failure of these services results in heavy burdens being placed on the population at large (Massoud, 2011). Relevant in particular to rural areas in South Africa, is that the availability of water for the farming of livestock has become an issue. The keeping of livestock indicates social status and prosperity, and is used as a means to increase food security; it is thus imperative that it is kept healthy. The ecosystems that are supported by rivers ensure subsistence, as local staple diets include fish as well as irrigated crops such as spinach (Le-Meur and Blundo, 2009).

Moreover, water can be regarded as a social good, as it is essential for a prosperous and healthy life. The provision of safe drinking water inevitably reduces mortality rates related to water-borne and water-related diseases, such as diarrhoea, cholera and malaria. This demands the good management of water for a functioning ecosystem that is able to deliver quality environmental goods and services. Human well-being and economic security are

clearly dependent on the protection of this resource (Harshfield, Jemec, Makhado and Ramarumo, 2010).

Africa is endowed with immense renewable natural resources, including fresh water resources. However natural phenomena such as climate change and rainfall pattern variability, coupled with human factors such as population growth, pollution and competition over water, threaten the sustainability of resources which largely affects poor people. In order to adequately mitigate these threats a radical change in approach is required (Molobella and Sinha, 2011). Water services play a dual role as it is a human right and a scarce natural resource that requires finance for its management. The fact that it is a human necessity and cannot be provided in an unlimited fashion poses many problems, especially in the Southern Hemisphere (Moe and Rheingans, 2006). In rural areas of these regions, water is known to be less secure, needs more financial support and time, and is usually more segregated (Crow and Sultana, 2002).

2.5.2 Distance to water in rural South Africa

Rural areas are geologically positioned to be scattered above flood plains and on top of hill tops. This is mainly done to avert diseases from water bodies and humid climates. The layout of traditional rural settlements poses a number of challenges for water provision. Approximately 6% of the national population, equating to 2.7 million people, live in the above-mentioned areas clustered in 1,500 settlements; 7,500 small villages have less than 5,000 people, whilst over 500 larger villages have more than 5,000 people (The Eastern Cape Economic Profile and Outlook, 2010).

Many rural communities lack access to water for their daily needs; people often walk long distances to a water source and collect water using traditional and regular water devices such as buckets. Steep slopes provide a great challenge, especially if travelling up hills, but often the geophysical structures of rocky and narrow path lead to water sources (Swartz, 2009). The construction cost of water infrastructure is generally high, owing to the unplanned hillside layouts of villages which are characterised by rocky soil conditions and

limited water resources. Most rural villages are isolated, which makes it even more expensive to supply and install water systems. Coupled with this, government has insufficient funding for this need (The Eastern Cape Economic Profile and Outlook, 2010).

Household activities require water, however only a minimal amount of water can be carried. Household activities that require water include, but are not limited to, irrigation, bathing, cooking and washing clothes. As a result, incidents of blisters, backaches, spinal aches and muscle aches are recorded from carrying heavy 20 litre (l) buckets a great distance (Swartz, 2000). More often than not, women and children, especially girls of childbearing age, fetch water. Households that do not possess wheelbarrows revert to carrying water on their heads, causing children to become too unhealthy to attend school (Swartz, 2009). Adults, on the other hand, are unable to work long hours on their land and increase their crops, making them inactive participants in the economy.

2.5.3 Main challenges of water supply in South Africa

2.5.3.1 Awareness and capacity levels of poor people

Bottlenecks in the labour market have created seasonal labour in urban areas, where the young and able are flocking to towns and cities, leaving non-migrant community members with low capacity behind. More frequent climate change. floods and heavy rainfall as well as longer droughts, has also left poor rural people without the capacity, resources, and support to deal with these changes, leading to poor management of water and sanitation (Swartz, 2009).

There is also a disparity in the perception of the benefits of interventions, which make it difficult to bring about behaviour change. Local government and the health and education sector lose interest in hygiene campaigns, which are short lived and lack a meaningful long-term change (Lenton, 2009).

2.5.3.2 Access to support for community-managed services

Community-managed water systems lack financial and technical support. This is due to the exclusion of the surrounding structures in their development, namely non-governmental and the private sectors. Although weak, the support fills gaps in resource innovative market solutions (Swartz, 2009).

The lack of reliable data to end users on both the national and international levels have severely hampered the decision-making initiatives of government. The lack of supporting legislation and policies, poor ownership of development strategies, and the lack of interest in developing new strategies, as well as taking on more responsibilities at national government level, are common challenges (Swartz, 2009).

2.5.3.3 Access to appropriate technology

Rural areas suffer from low density and a mobile population, therefore attempting to implement urban interventions has often failed. They lack technology for water supply and the operational, financial, and institutional resources required are too great to improve the basics of water and sanitation. “Lesser” technologies are not usually considered as solutions (Swartz, 2009).

Multiple uses of single systems create health hazards and threaten the longevity of facilities. Financial stability is the main challenge as it is difficult to strike a balance between physical capital and human capital.

An analysis of the need for the promotion of rural technology would result in focusing on the basic necessities of people. Five elements of social and economic infrastructure should be taken care of effectively by the local bodies and central government, namely health, education, drinking water, housing and electricity. Followed by these, the need for roads, efficient agricultural output, employment at grassroots level and telecommunications cannot be neglected (Swartz, 2009).

All these goals of rural development converge towards the development of effective rural technologies and a sound rural education to absorb technological innovations. Any developing country cannot become developed without the development of its rural base. Rural regions in our nation are still deprived of electricity and basic necessities; modern technology has not touched the lives of people even after 21 years of democracy. We have to ensure that rural beneficiaries are not just introduced to new technologies, but also entrusted with their use (Swartz, 2009).

2.6 Associated issues of rural water access in South Africa

2.6.1 Water access in rural South Africa as relevant to women

Women have the greatest dependency on water in a household, as they are the primary users. This has allowed them better knowledge on uses, location and storage (Inter-agency Task Force on Gender and Water, 2006). They acquire water from rivers, wells, canals, ditches and ponds, depending on the reason for use and closeness; each source produces different types of water and women have to use their discretion when utilising the water they obtain. Soft water, for example, is found off river beds and is usually preferred for drinking and washing of white clothes, whilst borehole water is considered for gardening and livestock as it is salty and sticky (Cleaver, 1998).

Water is used for domestic uses, including drinking, cooking, bathing, gardening or raising livestock (Crow and Sultana, 2002). Moe and Rheingans (2006) further reiterated that women are the main managers of water and bear the burden of poor service delivery. Seeing that water plays such an essential role in the daily running of households, it is only just that they should have an abundant supply to reduce workloads, however this is not the case - many water points are high energy consuming and travelling long distances is often required. Added to this is weak flow, team pumping and long queues (Cleaver, 1998). Despite this, the essential role of women in water today is still overlooked (Inter-agency

Task Force on Gender and Water, 2006). Cleaver (1998) noted a change in the emphasis of women in the planning and management of water and sanitation projects over the past decade. The result of this is positive as it will build skills, improve efficiency and include women in decision-making, leading to empowerment.

To reiterate this point, a study conducted by the International Water and Sanitation Centre on community water and sanitation projects, showed that projects that have the full participation of women are more successful than those that do not (this study included 15 countries and 88 different communities). The World Bank also found associations between women and the effectiveness of water and sanitation projects (Inter-agency Task Force on Gender and Water, 2006).

The Water for Life Project is an international project for a ten year period that acknowledges the importance of women and their participation in water development efforts (Inter-agency Task Force on Gender and Water, 2006). Resource management needs to take into account women's priorities and is easily achieved by including them in decision-making activities (Cleaver, 1998). The Inter-agency Task Force on Gender and Water (2006) suggests that since water and sanitation provide benefits to society and the economy, both the role of men and women need to be recognised. In this way, specific needs are taken into consideration from all social groups (Lesego, 2012).

It is important to note that whilst the participation of women through committees and processes has improved, they do not always benefit or represent the women in most need, as women with time constraints are less likely to contribute. Furthermore, participatory projects are based on gathering resources and sometimes exclude poor women (Cleaver, 1998).

A growing concern is that female-headed households are poorer and faced with economic deprivation. This is one of the policy issues facing South Africa (Hemson, 2002). Understanding these households' living conditions is vital for the development of water services and reducing poverty. Analysing the availability of water according to the gender of the heads of households helps form policies as well as interventions.

A collaborative approach is needed to overcome water and sanitation issues in our country. Akiwumi (2003) wrote that women need to be empowered in water projects by being given leadership roles; water is usually managed by power given to men in rural areas. Since women have experience and knowledge in this area, they will only enrich and add value to projects. Women should become central to water management and men need to work alongside them; failing to do so will only result in the loss of valuable knowledge (Bennett, 2008). However, gender divisions in traditional societies cause a problem as women are told to live in the shadow of their husbands. These societies vest all power and rights to men but allocate all water tasks to their women. Different criteria are used in evaluating water policies between women and men, hence the involvement of both is necessary. Bennett (2008) went further to argue that excluding women from water management will undermine water management initiatives and the consequences will be detrimental to communities.

In essence, the most effective water systems are lost as men are given priority in community participation in water planning, further leading to valuable opportunities being squandered. The heterogeneity of communities' needs about water and the communities' priorities must be recognised in all subgroups. Furthermore, all social actors need to be identified as well as their relations, responsibilities, roles and gender deviations. The benefits of equitable development are important and water must be a catalyst in doing so (Bennett, 2008).

2.6.2 Water, education and health in rural South Africa

2.6.2.1 Water access in rural South Africa as relevant to education

When households require water, women and children, usually girls, are frequently tasked with the collecting of water (Crow and Sultana, 2002). Girls show high levels of absenteeism compared to boys, as it is their duty to ensure that there is water in the house, which usually entails walking long distances. Cleaver (1998) stated that the work involved in acquiring water leaves girls with difficult choices, such as leaving school because of

time-consuming tasks. In an attempt to achieve gender equality, women and girls must be freed from backbreaking work such as collecting water. By doing so this will lead to greater economic possibilities, income generation and the attendance of young girls at school (Watkins *et al.*, 2006).

According to UNICEF (2006), female dropout rates are high as the tedious task of fetching water is time consuming. Inadequate water is one of the major causes of low female level education and few enrolments in rural areas. Access to water increases the long-term well-being of women and girls all around.

The Inter-agency Task Force on Gender and Water (2006) stated that water is a basic human right which is essential to achieve gender equality and development. Ensuring physical access to clean water enables women to pursue their education and provide better income generation for their family. Women can be strong contributors if they are given equal resources; they are able to increase production by 20-30 percent and potentially reduce the number of hungry people in the world by between 100 and 150 million (Food and Agriculture Organisation, 2010; 2011).

The second Millennium Development Goal is to “ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling” . The direct link between education and water indicates that high dropout rates can be attributed to poor water facilities at schools (UNICEF, 2006).

Children in school are affected by poor water services, as clean water is needed for healthy bodies and creates conditions conducive for learning. Water is essential for absorption, oxygen, digestion, maintaining body tone and moving nutrients to cells, and is a natural air conditioning system and rids bodies of all waste (Williams, 2005).

2.6.2.2 Water access in rural South Africa as relevant to health

Health is a hard-hit aspect affected by poor water. This is caused by unhygienic, unsanitary, and inadequate environmental conditions (Cunnam and Maharaj, 2000). In the rare cases

where there is piped water in rural areas, infrastructure directly to households has aged and is a danger as it may lead to contamination and waterborne diseases (Moe and Rheingans, 2006). Primary diseases caused by the lack of this service as highlighted by the HSRC (2012) include skin diseases, bilharzia, worms, malaria, diarrhoea, eye infections and Trachoma - a primary cause of irreversible blindness most commonly associated with poor sanitation and hygiene practices (Groce *et al*, 2011). These diseases place a burden on public healthcare and the economy. Four billion cases of diarrhoea are treated yearly with two million dying in developing countries (Massoud, 2011). Cuesta (2007) cited the above list as the most common diseases, and reported 15 million cases of diarrhoea in children less than five years of age. This is largely due to the lack of hygiene education (HSRC, 2012).

Bond (2011) discussed the challenge of improving health and reducing medical costs for governments. This challenge is mainly caused by pollution and the risk of contaminated groundwater, which leads to higher mortality rates, mainly among children.

Interventions need to be focused towards the environment, sanitation, food, water quality and hygiene. Pressure on the healthcare system can be eased if contamination free water is attained. This will largely improve the quality of life as well as the economic success of individuals, as the number of work days missed due to ill health will be reduced. \$28.4 billion a year is lost in Africa due to poor water and sanitation, as reported in 2009 by the United Nations Educational, Scientific, and Cultural Organization (UNESCO).

2.6.2.3 The effect of the distance of water in rural South Africa integrating education and health

Once water access is improved, the consolidation of hygiene education is imperative. Health and hygiene education promotes change through providing information (Harshfield *et al.*, 2009), and is imperative for attaining health and economic benefits through water programmes. The Water and Sanitation for Health Projects (1993) was of the same view and asserted that education is necessary to bring about changes in behaviour. This will inevitably sustain water improvements and progress public health. The course should be

based on a variety of factors, namely equipment, production, material and financial resources.

2.6.3 The distance to water in South Africa looking at housing

2.6.3.1 The current housing policy

The housing crisis reached its worst stage during the 1990s and the conditions faced were dire (Goebel, 2007). After the first democratic elections, the government realised houses needed to be produced on a large scale to counter the backlog, whilst at the same time they had to try to integrate development and ensure equal amenities for all (Lemanski, 2004).

After negotiations, the Housing Policy Framework was developed as part of the RDP (Goodlad, 1996). This plan served as a broad approach and took cognisance of other socioeconomic needs. In order to meet the drastic housing demand the government promised to build at least one million low cost houses annually. This proved difficult as the country was still at a point of transition (Department of Housing, 1995). Coupled with this was a shortage of affordable and available land that was suitable for building purposes (Goodlad, 1996; Huchzermeyer, 2001).

2.6.3.2 Integrating housing and water services

Water programmes need to take a holistic approach that encompasses potable water being available close to houses being built (Palmer Development Group and University of Cape Town, 1993). Without water the natural environment cannot be maintained (Hay, 2014), and it is therefore unsuitable for living and the building of houses.

Institutional problems hindered potable water initiatives and as a result housing programmes were affected. Programmes were previously lead by various departments

within the municipalities, which hampered the speed of delivery. Water and sanitation provision was the duty of engineering departments and housing by the housing department, however this fragmented approach was overcome when departments were integrated (Wood *et al*, 2001).

2.6.4 Potential environmental implications

While many citizens in South Africa received access to water systems, others experienced an ongoing lack of infrastructure, which is essential to balance the environment and improve the quality of life. Inadequate water systems negatively influence the natural environment by depleting it (Nwonwu, 2007). This occurs when on site sanitation systems are not developed properly and do not meet environmental standards (Choguill, 1996). This causes seepages and untreated or partly treated waste enters rivers. Runoffs from this cause a mechanism of transport for organic substances, micro organisms, nutrients and other pollutants (Umgeni Water, 1998). An increased nutrient load depletes oxygen from aquatic life. Furthermore, solids reduce the penetration of sunlight used by plants for photosynthesis and ultimately paralyse the entire ecosystem (DEAT, 1996).

2.7 Conceptual Framework

Figure 2.1 below is a schematic representation of the conceptual framework of this study. In section 2.7.1 the conceptual framework is explained.

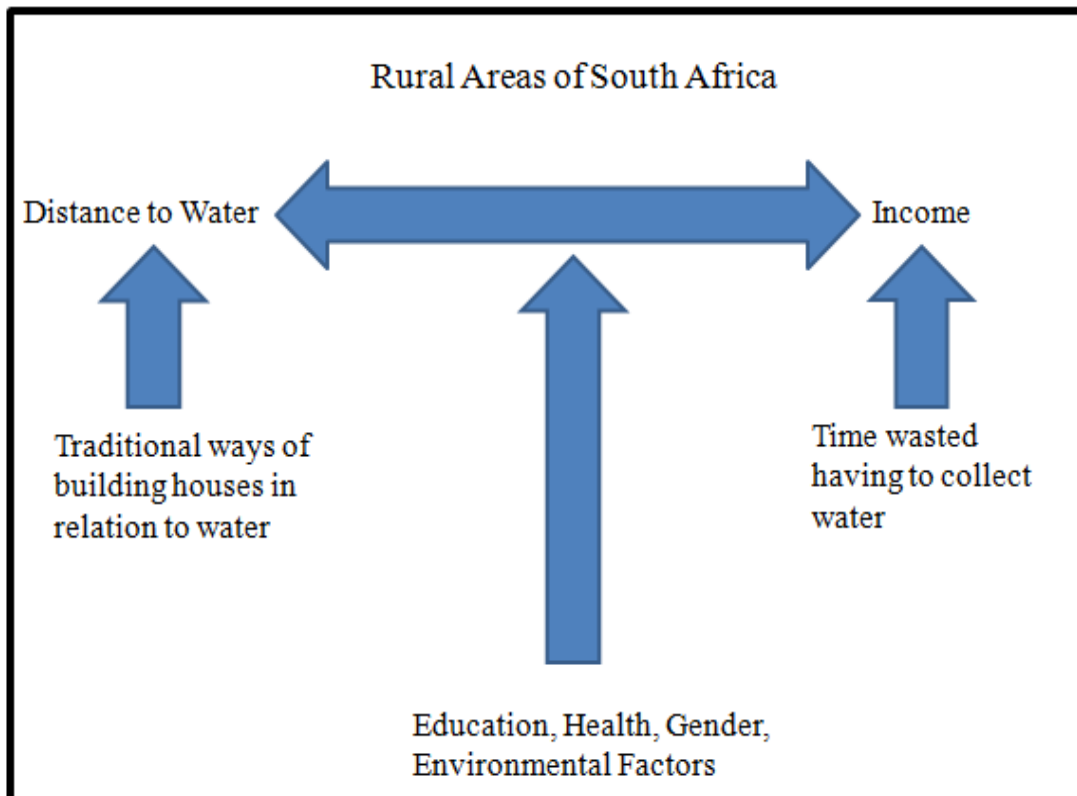


Figure 2.1: The conceptual framework for the study

2.7.1 Explaining the conceptual framework

The conceptual framework builds on the literature on the historic background concerning water and associated issues. Figure 2.1 above illustrates that traditional ways of building houses affect the distance to water.

The figure further attempts to show that time spent having to collect water from natural resources impedes growth of rural areas, as community members have less time to earn a living. Other areas hindered in this regard include, but are not limited to, education, health, gender equality and the environment. These factors form part of a bigger black box in between the two variables of distance and income.

The aim is thus to illustrate the relationship between the distance to water from households and income in rural areas in SA.

2.8 Conclusion

To understand the political, economic and social issues for the designing of policies, intervention and recommendations relevant to water access, the spatial distribution of the population in rural areas must be studied. Furthermore, disease control, preventative measures, drugs and health drives can be better directed with an understanding of the basic spatial patterns governing water access. This literature review discussed two determinates of rural placement patterns, namely apartheid and water access.

Water is essential for sustaining human life as it plays a vital role in many human activities, in addition to sustaining ecosystems that provide valuable services to both the environment and humans. Water access in rural areas is informed by government initiatives, but also by the environment, culture and religious beliefs of a community. The former was discussed in this chapter while the latter will be discussed in chapter 5.

The next chapter will discuss the methods utilised in this research. It will detail the methodology, sampling method, data collection and techniques used.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

The research undertaken was designed to achieve five objectives, which in turn may be used as facts to evaluate actions, describe situations and confirm the hypothesis. This entailed ensuring the facts revealed were measurable, accurate.

The purpose of this chapter is to present the methodology adopted for this study, the highlights, the sampling method, the data collection and the techniques used to analyse the data. Cognisance is given to the issue of reliability and validity as well as potential errors. Control measures are imperative and every effort was made by the researcher to limit them.

3.2. Aim and objectives of the study

The overall aim of this research was to establish whether there is a relationship between the distance from households to running or standing water bodies and income in rural South Africa.

The research was designed in such a way as to address the following research objectives:

- To identify data sources relevant to measure the distance to water and income
- To measure the distance to water using Google Earth™
- To look for patterns in the positioning of households in relation to water
- To extract income data
- To test for a significant relationship between the distance to water and income

3.3 The research design

The research design discusses the method used by the researcher to collect and analyse the data, as well as constraints that will be dealt with (Cooper and Schindler, 2001).

Research design by definition varies. This was reiterated by Cooper and Schindler (2003) and Welman and Kruger (2002), who noted that research design definitions differ in detail. The essentials can be summarised as the design aids with the selection of sources and types of information and is always based on research questions. The design framework can specify relationships amongst the variables in the study, which is usually time and activity based. Lastly, the design informs procedures and answers questions for every research activity, such as the techniques for data collection, sampling, as well as cost and time constraints.

According to Walliman (2005), the research problem must first be clearly defined and the data and analysis will become evident. The justification of methods is determined by characteristics of the research problem, sources of information and what the research aims to achieve. He went on to say that the type of research selected must be either quantitative or qualitative; then only can the type of data needed be established.

3.3.1. Type of research

Quantitative research is a formal, objective, systematic process in which numerical data are utilised to obtain information about the world (Welman and Kruger, 2002). For the purpose of this study, the researcher selected a quantitative research approach to establish if a relationship exists between water and income in the rural areas of South Africa.

This involves noting the characteristics of the observed phenomena and exploring correlations among them (Leedy and Ormrod, 2005). The major characteristics identified

include culture, tradition, and language, which will be discussed in greater detail in chapter 5.

3.3.2. Target population

South Africa's geo-physical structures are characterised by narrow, rocky and steep paths that lead to water resources. Rural communities have to travel vast distances to meet their daily water requirements using only traditional water devices such as buckets (Eastern Cape Economic Outlook, 2010).

The main selection criteria for the target communities were as follows:

- Service Delivery

The percentage of piped water in communities recorded by Statistics South Africa in 2011.

- Consumable Income

The average income of households during the same year.

- Locality

The distance rural communities have to travel to obtain water for use.

The population was drawn from the literature, which indicated the provinces of the Eastern Cape, KwaZulu Natal and Limpopo having poor access to piped water. This was highlighted by the researcher in sections 2.4.4 and 2.4.10 of this study.

Figure 3.1 Showing Selected Provinces and Communities



Figure 3.1: Adaptation of Google Earth™

Figure 3.1 shows the population and sample selected. The relevant provinces are indicated with red stars, and communities with yellow dots.

3.3.3. Sample, size and selection

The researcher had to collect enough data to fulfil the objectives and research questions of the study (Saunders, Lewis and Thornhill, 2003). Each and every possible case or group was studied in a census, however owing to cost and time constraints, it was impossible to

collect and analyse all the data available. Sampling techniques thus enabled the researcher to reduce the amount of data that needed to be collected, taking cognisance of only a sub-group, by providing a range of methods. Sampling is able to provide a sensible alternative to a census. This is best demonstrated when:

- To survey the entire population will be impractical;
- Budgeting hinders the surveying of the entire population;
- Time constraints are placed on the research; and
- All the data have been collected however timeless results are required (Saunders, Lewis and Thornhill, 2003).

Sampling design is comprised of two types, namely probability and non-probability sampling. The former sampling method is based on true random selection, while the latter is not based on a random procedure (Neuman, 1997; Saunders, Lewis and Thornhill, 2003). For the purpose of this study a non-random sampling method was undertaken, allowing for sampling units to be left to the discretion of the researcher. “Accidental or convenience sampling is the most convenient collection of the members of the population that are readily available for research purposes” (Welman and Kruger, 1999: 62).

The sample was drawn from nine rural communities in the earlier stated provinces of South Africa. These communities included Ntaboduli, Mdakeni, Matshona, Vongunzana, Dinsi, Sangweyana Estate, India, Sekwati and Ga-Mohwibidu. This sample was purposively selected to represent diverse cultures, mainly, Xhosa, Zulu and Pedi.

Owing to the fact that there was not an adequate sampling frame for the population, probability sampling was eliminated. It is impossible to identify an ideal sample size as good or bad, however a sample size of between 20-50 units can be considered good (Schlegemilch, 1997). A sample size of 270 - 30 households from each of the nine selected communities - was thus considered adequate for this research.

3.3.4. The research instrument

To reiterate, the main aim of the study was to establish if there is a relationship between the distance to water in rural areas and the earning power. The collecting of new data to fulfil the objectives of the study is referred to as primary data (Saunders, Lewis and Thornhill, 2003).

Primary data was ascertained using Google Earth™. The distance from approximately 30 selected households per community to their nearest standing or running water was measured. Thereafter, with the use of census data, the average household income of each community was plotted against the distance to water in metres. The data was then distinguished, analysed and tabulated, and graphically represented. This was regarded as the most suitable method of data collection for this study for the following reasons:

- The precise distance people from the communities had to travel was possible to measure;
- This was the most cost effective method given the geographical dispersion of the populations in the Eastern Cape, KwaZulu Natal, and Limpopo and the large number of target respondents.

In achieving the objectives of the study the following criteria were taken into account when identifying the research instruments:

- The reliability and capability of the data in proving or disproving the hypothesis;
- Relevance of the data to the research objectives.

3.3.4.1 Secondary data

Secondary research was undertaken as there was available information to answer the research problem, therefore the process of obtaining primary information directly from the source was unnecessary. Adequate and appropriate secondary sources were available for

the defined target population, this being the income data solicited from a Statistics South Africa official.

Furthermore, research instruments included literature on water and the key issues that characterised the current situation, newspaper articles and government reports that discussed the present state of water access in the country, and on-line sourcing using articles from the internet relating to water deficiencies.

3.4 Data capturing and processing

Data need to be edited before they are captured. In this case, this entailed ensuring that the accurate metre distance for each village was noted and uniformly entered for each of the 30 households in the nine communities (Tashakkori and Teddlie, 2002).

3.4.1 Data analysis

Once data is computerised and stored it can then be analysed. Tustin (2005) stated that a high quality set of data are of limited use if they are unable to be effectively captured.

Software packages were used to enable the entire data file to be edited. This made data analysis accessible and effortless by allowing for easy computerised retrieval. In this way the data were defined for simple storage and interpretation with the aid of spreadsheets and tabulated representation (Tashakkori and Teddlie, 2003).

Data obtained from Google EarthTM was in the form of grouped data. Grouped data statistics were then used to determine the central measures and standard deviations. Analysis was then performed using GraphPad Prism version 5.04.

3.4.1.1 One-way analysis of variance

If the population is normally distributed, then a one-way ANOVA can compare three or more groups.

P value

A P value tests the null hypothesis, which states that samples from all groups are from populations with identical means. When P is calculated to be large then means are identical, and when P is small, at least one mean differs from the rest. Other post-hoc tests were done to reveal where the differences actually lay, and will be discussed in the sections to come.

F ratio

The F ratio is the ratio of two mean square values. F is usually close to 1 when the null hypothesis is proven. When F is large this means the variation is larger than expected, owing to either the data not being sampled from populations with the same mean or sampling shows large values in some groups while small values in other.

R squared

R^2 is calculated by comparing all variance among means with the variability within groups (Zar, 2010).

A one-way analysis of variances comprises of one way, ANOVA routine. This is usually quicker to perform and allows for multiple test comparisons (Saunders, Lewis and Thornhill, 2003). ANOVA one-way testing was used by the researcher to compare mean distance and income among and between the provinces.

3.4.1.2 Bartlett's test for equal variances

Bartlett's tests are used to verify analysis of variance where it is assumed that variance are equal across data sets, known as homogeneity or homoscedasticity. Here, departures from normality are heavily sensitised (Zar, 2010). In essence the researcher tested whether

variances were equal against whether variances were unequal for at least two data sets, for both income and distance, to confirm the results from the ANOVA analysis.

3.4.1.3 Kruskal-Wallis test

In order to determine if samples come from different populations, the Kruskal-Wallis test must be done to compare medians of two or more samples that are independent of each other and that have different sample sizes. Being non-parametric it does not assume normal distribution (McKnight and Najab, 2010).

This test was utilised by the researcher to establish a null hypothesis or alternative hypothesis. The former maintains that all group medians are equal and the latter that one population median is different than the population median of at least one other group. In order to do this test the researcher had to first make stringent assumptions for all groups, except for differences in medians (McKnight and Najab, 2010).

The Kruskal-Wallis test was performed as the data satisfy the conditions for testing, which include but are not limited to:

- The sample size was equal with very small differences;
- The income and distance were independent from each other;
- There were more than five data points; and
- Variances were not equal

3.4.1.4 Dunn's Multiple Comparison Test

This test enables a researcher to do multiple comparisons, such as compare the mean of each group against the other, compare the mean group against the control group or compare specified columns (Tashakkori and Teddlie, 2002). The researcher compared the mean

groups of all communities against each other for both income and distance, looking at the significance level α being 0.05.

3.4.1.5 Tukey's Multiple Comparison Test

This test is done to find means that are significantly different from each other by comparing all possible pairs of means. It identifies means that are greater than the expected standard error. When all sample sizes are equal, exactly $1-\alpha$. For unequal sample sizes, the confidence coefficient is greater than $1-\alpha$ (Tashakkori and Teddlie, 2002). The researcher conducted this test after the ANOVA analysis to ensure integrity once again. While the ANOVA analysis revealed that differences did occur it did not show where, hence the post-hoc testing. The researcher performed these, acknowledging that the conclusions would be weaker compared to pre-planned tests.

3.4.1.6 Correlation between income and distance

Correlation can be described as a technique that depicts how strongly a pair of variables are related; +1 and -1 are used to represent the strength (Field, 2006). Bivariate correlation was employed by the researcher to test the strength of the relationship between income and distance. If this relationship was strong the value would be close to 1 and vice-versa. The relationship was tested to be either positive, which will mean that as income increases so does distance, or negative, indicating the increase in one variable results in the decrease of the other (Field, 2006). Regression was not used in this regard as there was a possibility that income may also influence distance to water, therefore a method that is called “independent variable” was not strictly suitable for this study.

3.5. Reliability, validation and bias

3.5.1 Reliability

Reliability refers to achieving consistency in studies (White, 2000). The research methods ensured that if another researcher conducted a similar study, similar findings would result.

A measurement process being free from random errors is known as reliability. Moreover, it is the extent to which findings can be generalised to other situations; reliability will therefore decrease as errors increase. The researcher used a population sample of 270 households to enhance reliability. The same set of actions must elicit the same results if the same activities are recast (Leedy and Ormrod, 2005). Variables are regarded as reliable and stable only after repeated administration of the test.

The relationship between reliability and validity can be described in the following sentence: A test can be reliable and not valid, but never valid and not reliable (Weiner, 2007)

3.5.2 Validity

The process of research being both systematic and random error free is referred to as validity, i.e. it ensures that what is intended to be measured gets measured and the independent and dependent variables are properly identified (Goddard and Melville, 2001). Validity varies in degree from low to high, therefore a pre-test was conducted for this study. The following questions were given priority:

1. Does the research actually measure the distance to water?
2. Does the research actually analyse average income of the communities against distance?
3. Does the research measuring instrument agree with the research objectives?

For this study the following two types of validity were considered:

The extent to which a measure appears to measure the characteristic it is supposed to is referred to as content validity. It is also known as how well data represents the entire population, which relies on the instruments used to collect data (Leedy and Ormrod, 2005). It can also refer to the entire subject of interest being properly sampled. A content validity test was used to test the sampling method for this study.

The second means of validity utilised was construct validity, whereby the question of “does each item behave as expected with the use of a consistent research instrument?”. Here the hypothesis is either confirmed or rejected (Leedy and Ormrod, 2005).

The following steps were taken to ensure the validity of the study:

- Data were collected from reliable sources.
- Research methods were based on the literature to fulfil the research objectives.
- Data had been collected over two weeks. Within this short period, no major event changed within the related topic.

Notwithstanding this, census data were utilised therefore no reliability and validation was required. With the use of Google Earth™ the distance was calculated twice at two different intervals.

3.5.3 Bias

When findings deviate from “true findings”, a systematic error has occurred which is known as „bias in research“ (Leedy and Ormrod, 2005). Bias was encountered in selecting the communities and houses within communities. Attempts were made to minimise this bias within communities and at the whole-community level. The researcher carefully checked that these were representative.

3.6 Conclusion

This chapter explained how data were collected and analysed. The research design was discussed as well as population and sampling methods, with justifications for choosing particular methods. Reliability, validity and bias were then defined for this research. The next chapter will graphically represent the data collected, and analyse them in terms of differences and relationships.

CHAPTER 4: RESULTS

4.1 Introduction

This chapter presents the results and discusses the findings obtained from the data in this study. The results are presented in the form of graphs, cross tabulations and other figures for the data that were collected. Inferential techniques included the use of ANOVA and correlations, which were interpreted using the p-values.

4.2 The sample

The sample included nine communities across three provinces: the Eastern Cape (Ntaboduli, Mdakeni, Matshona), KwaZulu Natal (Vongunzana, Dinsi, Sangweyana Estate) and Limpopo (India, Sekwati, Ga-Mohwibidu).

The distance from approximately 30 selected households of the nine communities to their nearest standing or running water was ascertained using Google EarthTM, using the unit of metres.

4.3 Analysis of income

4.3.1 Summary of The Mean Income and Standard Deviation by Communities and Province

Table 4.1 Mean Income for Each Community

		Mean Income		Standard Deviation - Income	
		District (R)	Province(R)	District(R)	Province(R)
EC	NTABODULI	422053.28	430269.03	17133834.37	17179435.13
	MDAKENI	444867.56	430269.03	17497727.58	17179435.13
	MATSHONA	427597.64	430269.03	17036682.07	17179435.13
KZN	VONGUNZANA	521689.54	516886.88	19346659.21	19192201.90
	DINSI	476521.50	516886.88	18925337.13	19192201.90
	SANGWEYANA ESTATE	563048.12	516886.88	19369174.55	19192201.90
LIMPOPO	SEKWATI	467134.14	468963.73	17002774.72	18039544.59
	INDIA	527997.50	468963.73	20563385.01	18039544.59
	GA- MOHWIBIDU	441294.72	468963.73	17638323.78	18039544.59

Table 4.1 diagrammatically represents Sangweyana Estate in KZN as having the largest mean income of all the communities at R563,048.12, and Ntaboduli in the EC with a mere R422,053.28.

4.3.2 Summary of the Mean Income and Standard Deviation by Communities and Province

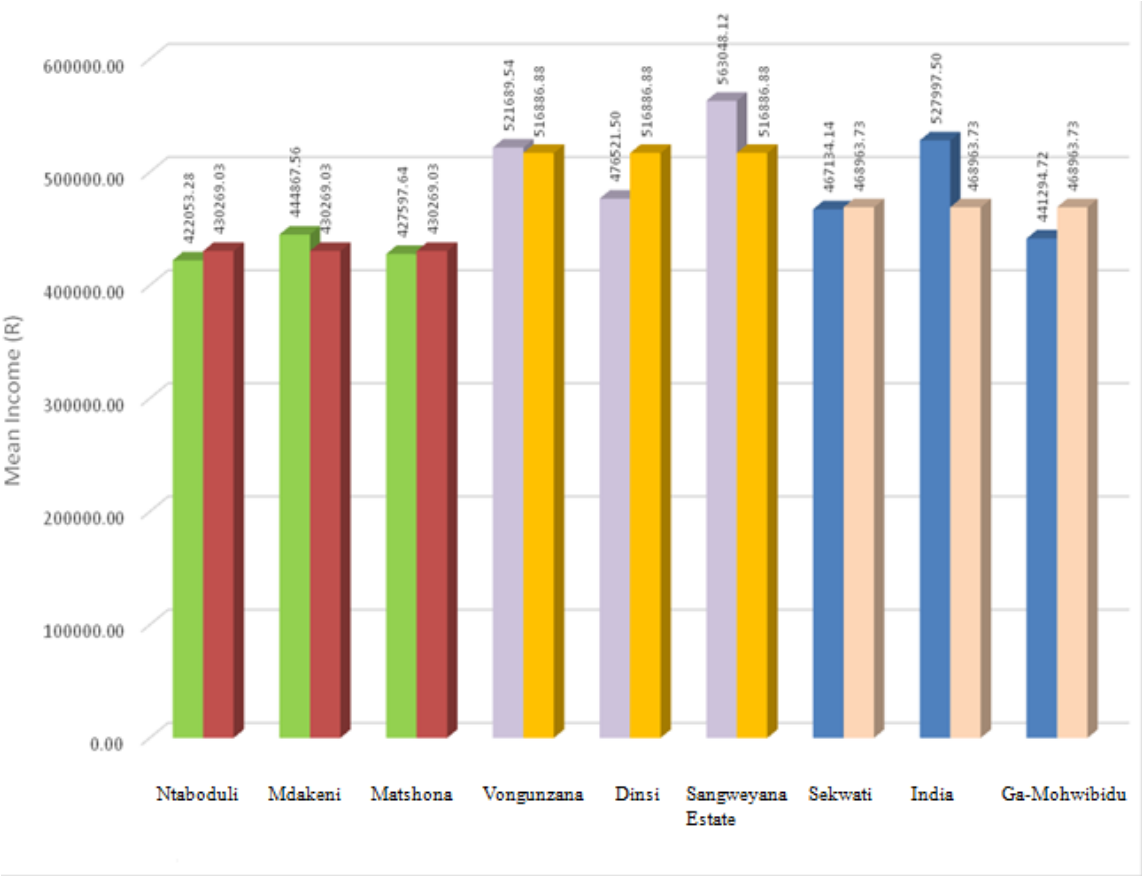


Figure 4.1 Mean Income

It is evident that the incomes for the Eastern Cape region are the lowest, whilst those for KZN are highest.

4.3.3 Analysis of income mean differences

4.3.3.1 Analysis Within Provinces

Differences between the mean incomes of the communities within each province are marginal in some instances. The significance of these differences are tested below.

Table 4.2 Income Differences between the Communities Within Each Province

	Eastern Cape	KZN	Limpopo
One-way analysis of variance			
P value	1.0000	0.9995	0.9994
P value summary	Ns	ns	ns
Are means significantly different? (P < 0.05)	No	No	No
Number of groups	3	3	3
F	0.00004772	0.0005073	0.0005811
R squared	0.0000003214	0.000003416	0.000003913
Bartlett's test for equal variances			
Bartlett's statistic (corrected)	0.07834	0.06691	4.129
P value	0.9616	0.9671	0.1269
P value summary	Ns	ns	ns

Do the variances differ significantly? ($P < 0.05$)	No	No	No
----------------------------------------------------------	----	----	----

Table 4.2 shows the analysis of income variance between communities within provinces, and it is observed that within each province there is no statistically significant difference in the mean values ($p > 0.05$).

4.3.3.2 Analysis between communities

The communities' comparison revealed the following for income:

Table 4.3 Income Differences between Communities

One-way analysis of variance	
P value	1.0000
P value summary	Ns
Are means significantly different? ($P < 0.05$)	No
Number of groups	9
F	0.0007399
R squared	0.000006643

Table 4.3 indicated that although there are differences in the means between the communities, the differences were not statistically significant ($p > 0.05$).

4.3.3.3 Testing for significance for income

Table 4.4 Mean Income Significance

One-way analysis of variance	
P value	< 0.0001
P value summary	***
Are means significantly different? (P < 0.05)	Yes
Number of groups	9
F	915.9
R squared	0.9656

4.3.3.4 ANOVA for income

Table 4.5 Testing Between and Within Provinces

ANOVA Table	SS	Df	MS
Treatment (between columns)	114700000	8	14340000
Residual (within columns)	4086000	261	15660
Total	118800000	269	

4.3.3.5 Post-Hoc Testing for income

Table 4.6 Tukey's Multiple Comparison Test between Communities for Income

	Mean Diff.	q	Significant ? P < 0.05?	Summary	95% CI of diff
NTABODULI VS. MDAKENI	467.4	20.46	Yes	***	365.4 to 569.4
NTABODULI VS. MATSHONA	513.5	22.48	Yes	***	411.5 to 615.4
NTABODULI VS. VONGUNZANA	-1600	70.02	Yes	***	-1701 to -1498
NTABODULI VS. DINSI	463.4	20.28	Yes	***	361.4 to 565.4
NTABODULI VS. SANGWEYANA ESTATE	527.1	23.07	Yes	***	425.1 to 629.1
NTABODULI VS. SEKWATI	446.2	19.53	Yes	***	344.2 to 548.2
NTABODULI VS. INDIA	465.3	20.37	Yes	***	363.3 to 567.3
NTABODULI VS. GA-MOHWIBIDU	462.7	20.26	Yes	***	360.7 to 564.7
MDAKENI VS.	46.05	2.016	No	ns	-55.93 to 148.0

MATSHONA					
MDAKENI VS. VONGUNZANA	-2067	90.48	Yes	***	-2169 to -1965
MDAKENI VS. DINSI	-4.040	0.1768	No	ns	-106.0 to 97.94
MDAKENI VS. SANGWEYANA ESTATE	59.72	2.614	No	ns	-42.26 to 161.7
MDAKENI VS. SEKWATI	-21.21	0.9284	No	ns	-123.2 to 80.77
MDAKENI VS. INDIA	-2.120	0.09280	No	ns	-104.1 to 99.86
MDAKENI VS. GA-MOHWIBIDU	-4.680	0.2049	No	ns	-106.7 to 97.30
MATSHONA VS. VONGUNZANA	-2113	92.49	Yes	***	-2215 to -2011
MATSHONA VS. DINSI	-50.09	2.193	No	ns	-152.1 to 51.89
MATSHONA VS. SANGWEYANA ESTATE	13.67	0.5984	No	ns	-88.31 to 115.7
MATSHONA VS. SEKWATI	-67.26	2.944	No	ns	-169.2 to 34.72
MATSHONA VS.	-48.17	2.109	No	ns	-150.2 to 53.81

INDIA					
MATSHONA VS. GA-MOHWIBIDU	-50.73	2.221	No	ns	-152.7 to 51.25
VONGUNZANA VS. DINSI	2063	90.30	Yes	***	1961 to 2165
VONGUNZANA VS. SANGWEYANA ESTATE	2127	93.09	Yes	***	2025 to 2229
VONGUNZANA VS. SEKWATI	2046	89.55	Yes	***	1944 to 2148
VONGUNZANA VS. INDIA	2065	90.38	Yes	***	1963 to 2167
VONGUNZANA VS. GA- MOHWIBIDU	2062	90.27	Yes	***	1960 to 2164
DINSI VS. SANGWEYANA ESTATE	63.76	2.791	No	ns	-38.22 to 165.7
DINSI VS. SEKWATI	-17.17	0.7516	No	ns	-119.2 to 84.81
DINSI VS. INDIA	1.920	0.08405	No	ns	-100.1 to 103.9
DINSI VS. GA-MOHWIBIDU	-0.6400	0.02802	No	ns	-102.6 to 101.3

SANGWEYANA ESTATE VS. SEKWATI	-80.93	3.543	No	ns	-182.9 to 21.05
SANGWEYANA ESTATE VS. INDIA	-61.84	2.707	No	ns	-163.8 to 40.14
SANGWEYANA ESTATE VS. GA-MOHWIBIDU	-64.40	2.819	No	ns	-166.4 to 37.58
SEKWATI VS. INDIA	19.09	0.8356	No	ns	-82.89 to 121.1
SEKWATI VS. GA-MOHWIBIDU	16.53	0.7236	No	ns	-85.45 to 118.5
INDIA VS. GA-MOHWIBIDU	-2.560	0.1121	No	ns	-104.5 to 99.42

Table 4.6, Tukey's test, indicated where the significant differences in incomes are by using an asterisk. There were a number of significant differences, in particularly when Ntaboduli is compared to the other eight communities. Other significant differences was shown when Vongunzana was compared to Dinsi, Sangweyana Estate, Sekwati, India and Ga-Mohwibidu.

4.4 Analysis of distance

A similar analysis was done for distances as income.

4.4.1 Summary of the distance by communities and province

Table 4.7 Mean Distance for Each Community

		Mean Distance		Standard Deviation - Distance	
		District	Province	District	Province
EC	NTABODULI	726.12	1197.50	160.83	315.42
	MDAKENI	258.71	1197.50	168.09	315.42
	MATSHONA	212.66	1197.50	66.65	315.42
KZN	VONGUNZANA	2325.62	929.12	105.98	82.23
	DINSI	262.75	929.12	189.44	82.23
	SANGWEYANA ESTATE	198.99	929.12	48.93	82.23
LIMPOPO	SEKWATI	279.92	804.14	96.24	259.72
	INDIA	260.83	804.14	99.30	259.72
	GA-MOHWIBIDU	263.39	804.14	117.10	259.72

Table 4.7 diagrammatically shows Vongunzana and Sangweyana Estate as having the largest and smallest mean distances, both of which are within the province of KZN.

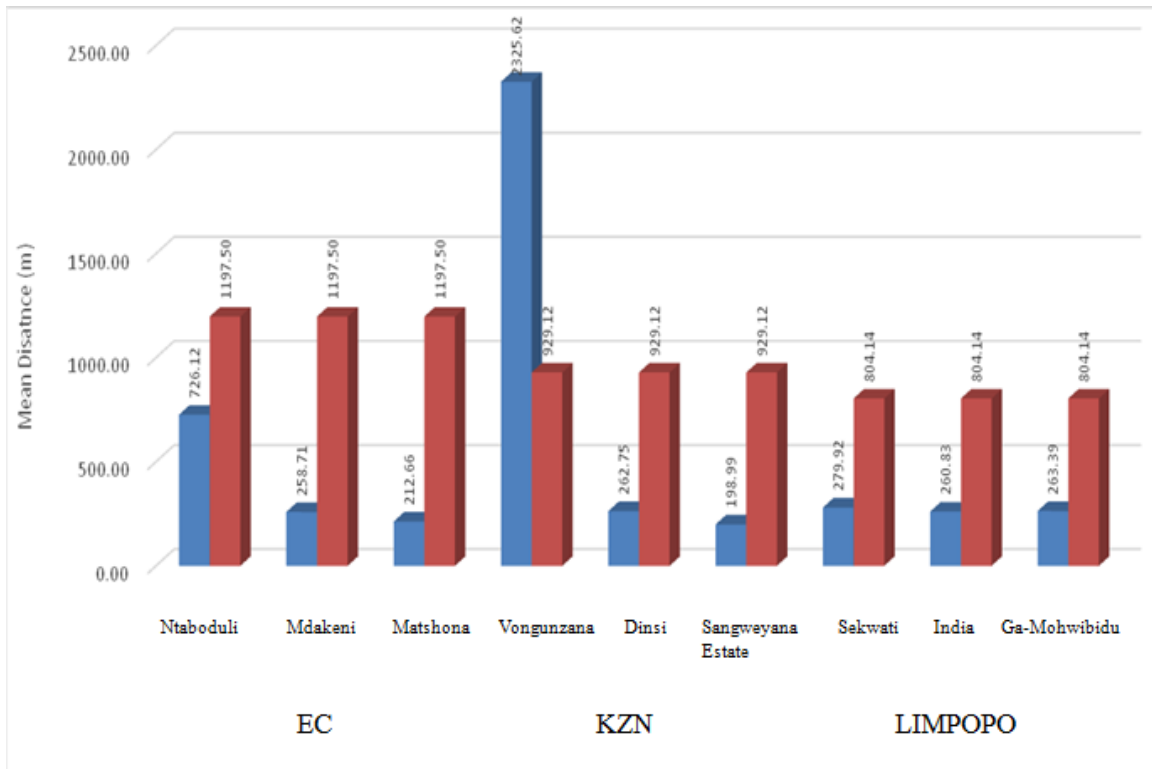


Figure 4.2 Mean Distance

It is apparent from Figure 4.2 that the Eastern Cape communities build houses the furthest from water sources, while KwaZulu Natal builds the closest, with the exception of the Vongunzana community.

4.4.2 Distance of households to water

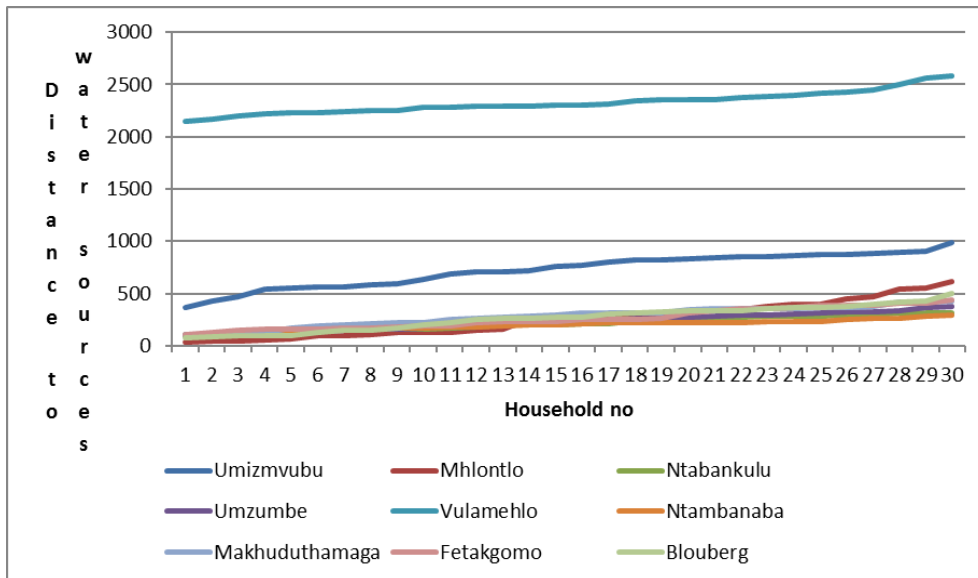


Figure 4.3 Distribution of distance to water sources according to communities

Figure 4.3 shows the distance of each of the 30 households to water in each community. Vongunzana shows the furthest distance with Ntaboduli the second.

4.4.3 Analysis of mean differences for distance

Table 4.8 Testing Distance Significance

	Eastern Cape	KZN	Limpopo
One-way analysis of variance			
P value	< 0.0001	< 0.0001	0.7458
P value summary	***	***	ns
Are means significantly different? (P < 0.05)	Yes	Yes	No
Number of groups	3	3	3
F	124.0	2661	0.2943
R squared	0.7403	0.9839	0.006720

It is noted that in Table 4.8 the distances do vary significantly in the Eastern Cape and KZN ($p < 0.05$), whilst the mean distances in Limpopo are not that different by communities.

4.4.4 Analysis between communities for distance

Table 4.9 Differences Between Communities for Distance

One-way analysis of variance	
P value	< 0.0001
P value summary	***
Are means significantly different? (P < 0.05)	Yes
Number of groups	9
F	915.9
R squared	0.9656

Table 4.9 shows significant differences were found due to the variations observed in the Eastern Cape and KZN.

4.4.5 Testing for significance for distance

Table 4.10 Identifying Significant Differences

Kruskal-Wallis test			
P value	< 0.0001		
Exact or approximate P value?	Gaussian Approximation		
P value summary	***		
Do the medians vary significantly? (P < 0.05)	Yes		
Number of groups	9		
Kruskal-Wallis statistic	147.5		
Dunn's Multiple Comparison Test	Difference in rank sum	Significant? P < 0.05?	Summary
NTABODULI VS. MDAKENI	116.3	Yes	***
NTABODULI VS. MATSHONA	134.9	Yes	***
NTABODULI VS. DINSI	118.1	Yes	***
NTABODULI VS.	-32.43	No	ns

VONGUNZANA			
NTABODULI VS. SANGWEYANA ESTATE	143.6	Yes	***
NTABODULI VS. SEKWATI	94.37	Yes	***
NTABODULI VS. INDIA	107.1	Yes	***
NTABODULI VS. GA-MOHWIBIDU	106.2	Yes	***
MDAKENI VS. MATSHONA	18.53	No	ns
MDAKENI VS. DINSI	1.767	No	ns
MDAKENI VS. VONGUNZANA	-148.8	Yes	***
MDAKENI VS. SANGWEYANA ESTATE	27.27	No	ns
MDAKENI VS. SEKWATI	-21.97	No	ns
MDAKENI VS. INDIA	-9.267	No	ns
MDAKENI VS. GA-MOHWIBIDU	-10.13	No	ns
MATSHONA VS. DINSI	-16.77	No	ns
MATSHONA VS. VONGUNZANA	-167.3	Yes	***
MATSHONA VS. SANGWEYANA ESTATE	8.733	No	ns

MATSHONA VS. SEKWATI	-40.50	No	ns
MATSHONA VS. INDIA	-27.80	No	ns
MATSHONA VS. GA-MOHWIBIDU	-28.67	No	ns
DINSI VS. VONGUNZANA	-150.5	Yes	***
DINSI VS. SANGWEYANA ESTATE	25.50	No	ns
DINSI VS. SEKWATI	-23.73	No	ns
DINSI VS. INDIA	-11.03	No	ns
DINSI VS. GA-MOHWIBIDU	-11.90	No	ns
VONGUNZANA VS. SANGWEYANA ESTATE	176.0	Yes	***
VONGUNZANA VS. SEKWATI	126.8	Yes	***
VONGUNZANA VS. INDIA	139.5	Yes	***
VONGUNZANA VS. GA-MOHWIBIDU	138.6	Yes	***
SANGWEYANA ESTATE VS. SEKWATI	-49.23	No	ns
SANGWEYANA ESTATE VS. INDIA	-36.53	No	ns
SANGWEYANA ESTATE	-37.40	No	ns

VS. GA-MOHWIBIDU			
SEKWATI VS. INDIA	12.70	No	ns
SEKWATI VS. GA-MOHWIBIDU	11.83	No	ns
INDIA VS. GA-MOHWIBIDU	-0.8667	No	ns

Dunn’s test in Table 4.10 indicates where the significant differences in distances are with an asterisk. Significance was found in the comparison of Ntaboduli and other communities, as well as with Vongunzana.

4.6 Correlation between income and distance

A bivariate correlation was also performed on the data. The results indicate the following patterns:

Positive values indicate a directly proportional relationship between the variables while a negative value indicates an inverse relationship. All significant relationships are indicated by asterisks. The table and figures below look at the correlation values between the two variables.

The first analysis was done with all of the data. The results are shown in Table 4.11 below.

Table 4.11 Correlation Using All Data Sets

Number of XY Pairs	8
Pearson r	0.3034
95% confidence interval	-0.5106 to 0.8306
P value (two-tailed)	0.4651
P value summary	Ns
Is the correlation significant? (alpha=0.05)	No
R squared	0.09205

The correlation coefficient (r) is 0.303, which results in a coefficient of variation of 0.09205. This means that approximately 9% of the variation in income can be described for a unit change of variation in distance.

The correlation is thus not significant ($p = 0.4651$), as illustrated by Figure 4.5.

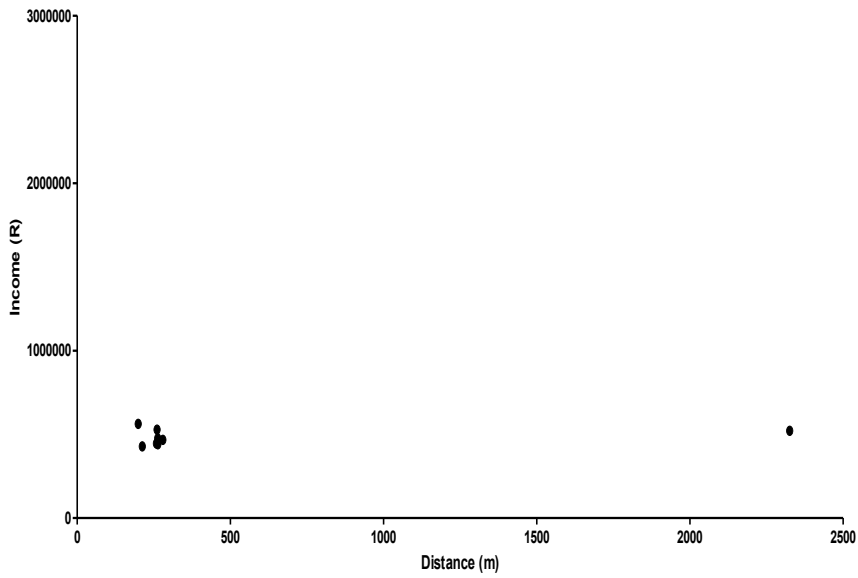


Figure 4.4 Correlation using all data sets

Table 4.12 Correlation Between the Two Variables

Correlations			
		VAR00001	VAR00002
VAR00001	Pearson Correlation	1	.228**
	Sig. (2-tailed)		.000
	N	270	270
VAR00002	Pearson Correlation	.228**	1
	Sig. (2-tailed)	.000	
	N	270	270
**. Correlation is significant at the 0.01 level (2-tailed).			

The results indicated that there is a statistically significant positive relationship ($r = 0.23$, $p < 0.01$) between household income and distance to water sources. This means that households with higher incomes were situated further away from the water sources.

Excluding the outlier distance values, the calculations were redone and the results are presented below in Table 4.13.

Table 4.13 Correlation excluding the outlier distance values

Number of XY Pairs	7
Pearson r	-0.3389
95% confidence interval	-0.8700 to 0.5563
P value (two-tailed)	0.4571
P value summary	Ns
Is the correlation significant? (alpha=0.05)	No
R squared	0.1148

Figure 4.5 illustrates the data presented in Table 4.13

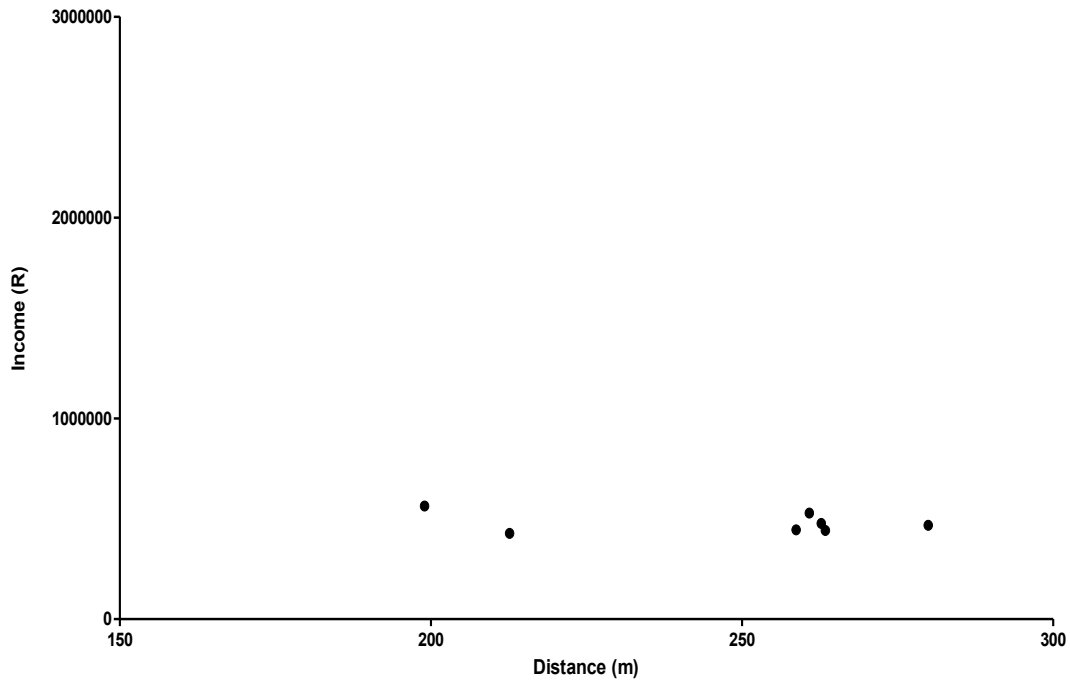


Figure 4.5 Correlation Excluding the Outlier Distance Values

The overall patterns are similar to those presented before, but the r value is now -0.34 . This is an inverse relationship indicating that as distance increases income decreases, and vice versa. In this instance, 11% of the variation can be explained, however the p -value indicates that this is not significant either.

Figure 4.6 below illustrates distance in relation to income for each of the 270 households.

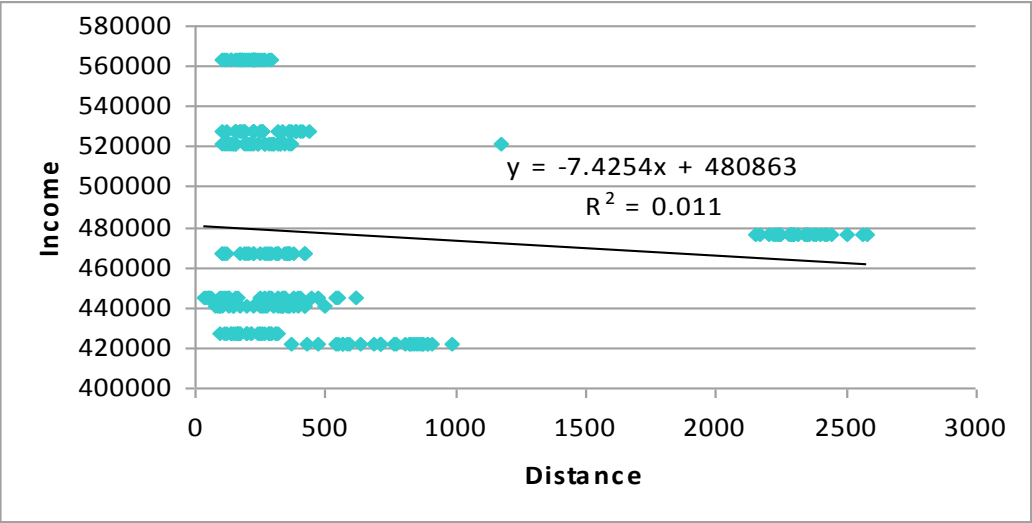


Figure 4.6 Distance and Mean Income for Each Household

The P value is 0.09. Although this cannot be considered significant ($P > 0.05$), it is nevertheless very close to significance.

4.7 Conclusion

A variety of tests were performed and represented in this chapter, including comparisons between and within the provinces, and tests of general relationships between the variables considered. The explanation of these results will be backed up with relevant literature in the next chapter.

CHAPTER FIVE: DISCUSSION

5.1 Introduction

This chapter will discuss the main findings on income and distance for the sampled provinces of the Eastern Cape, KwaZulu-Natal and Limpopo, in response to the research objectives. First of all it must be noted that there were clear and significant differences in both variables considered, both between and within provinces. More importantly, the relationship between income and distance to water, although not significant, was indicative of a genuine connection. Given the simple approach taken here which only used secondary data, as well as not being able to attach income values directly to the households for which distance to water was measured, the nearly-significant negative relationship between income and distance to water can be viewed as a remarkably encouraging result.

This chapter will review those aspects that are potentially relevant to the patterns observed, and which were not included in the literature review. The differences between and within provinces, as well as the deviations from the expected relationship between variables, can relate to a variety of factors too complex to quantify here, but which can be brought into the discussion. These include beliefs, cultures, populations, languages, religions and suitability of terrain.

5.2 Income

The mean income for provinces showed that KZN has the largest mean and the Eastern Cape the smallest. This can be explained in reference to the economy of the provinces.

5.2.1 KwaZulu Natal

Durban is the third richest city in South Africa and has a comparative advantage over other cities due to its exported-related industries and close proximity to the main harbour. Moreover, a large source of income is tourism-based. The Richards Bay port is the largest mineral processing and sand-mining operation in the world, positioning SA as the second largest exporter of steam coal. Exponential industrialisation has occurred in this province, which is reflected in the highest average mean of the three sampled provinces. In addition sugar cane is central to the agricultural economy, which is due to good rainfall and fertile soil (Trade and Investment KZN, 2012).

This research finds Sangaweyana Estate as having the larger mean which may have to do with broader factors affecting the Ntambanana Local Municipality in which it falls under. Ntambanana Local Municipality showed a negative growth rate of -1.85%, but decreased unemployment (Stats SA, 2011). This may be linked to the fact that most of the rural communities considered here derive their income within the province where they are located.

5.2.2 Limpopo

Mining in Limpopo contributes to a fifth of the provincial economy and mineral deposits include middle-grade coal, iron ore, chromium, diamonds, phosphate, antimony and copper. Mineral reserves also found in this province are silicon, mica, scheelite, vermiculite and gold, to name a few. Moreover, potatoes, mangoes, avocados and papayas are mainly produced in this region, which may be a staple diet for many poor people (Regional Growth Report, 2010). In essence, the local communities in this province are more integrated with the province's main sources of economic income, as opposed to the other researched provinces.

Research findings for the India community depict this village as having a much higher mean income than the other villages within the province. Research into the reasoning of this shows Fetakgomo as the local municipality of India, with growth of 0.13% (Stats SA,

2011). This made Fetakgomo one of two local municipalities with positive growth rates of the sampled population.

5.2.3 Eastern Cape

The metropolitan areas of Eastern Cape are Port Elizabeth and East London, which are primarily responsible for automotive manufacturing in South Africa. The province has been earmarked for economic development and growth because of its lagging progress. Other sectors are capital goods, tourism, renewable and green industries, pharmaceuticals, forestry and timber processing, and plastics and chemicals. Furthermore, agriculture activities are prominent while sheep farming is present in the Karoo (Eastern Cape Growth Summary Report, 2011). Nevertheless, it may be assumed that a vast proportion of the population in the areas under consideration here are simply living off the land. This can be substantiated by noting the rising unemployment rate in the Eastern Cape, which reached 30.9% in 2013 (Survey Socio-Economic Review and Outlook, 2013). Moreover, some members of the communities hold employment in other provinces and some within the greater EC area, primarily in the mining sector. The United States Geological Report records 42 mines existing in EC. The Eastern Cape remains one of the poorest provinces in the country with a high population, a lack of infrastructure, an inferior education system and high poverty caused by apartheid (Survey Socio-Economic Review and Outlook, 2013).

This research shows that mean income in the sampled villages have more or less the same average mean, which can be attributed to the poor economies of the local municipalities under which these villages fall. Statistics SA (2011) confirmed the researcher's results by reporting high unemployment rates of 49.9% and 48.9% for the local municipalities of Umzimvubu and Mhlontlo, respectively. The local municipalities for the three villages all show negative growth rates: -0.55% for Umzimvubu and Ntabankulu, and -0.75% for Mhlontlo.

5.2.4 Conclusion

Although the researcher noted the abovementioned differences in mean income, they do not appear to be significant amongst all villages within the province and amongst all villages. This confirms the researcher's initial thoughts that rural areas across SA experience similar challenges, regardless of the economies of the province (Rural Poverty Report, 2011).

5.3 Distance to water

The mean distance of each province was compared and this research showed that Limpopo, KZN and the Eastern Cape respectively were ranked nearest-to-water.

5.3.1 Limpopo

Limpopo lies on the northernmost area of South Africa and has bushveld, indigenous forests, mountains and farmland. Limpopo is the fifth largest of the provinces, occupying 10.3% of land in SA. The population was recorded to be 5.4 million people in 2011. sePedi is spoken by more than half of the provincial population (Stats SA, 2011).

Winter is moderate and frost-free, usually with mist in the mountains. Several private game reserves and 54 provincial reserves take up much of the land area. The areas selected in this province fall within the highveld plateau perimeters, therefore villages would have had plenty of grassland to set up settlements (Mucina and Rutherford, 2006).

In relation to the other two provinces Limpopo has the most similarity in mean distance amongst its villages, and the abovementioned factors of suitability of terrain, land space, population and climate would inevitably effect the placement of villages. This research showed that villages in Limpopo build houses close to each other, which also influenced placement in relation to water. This can link back to the income aspect in this province, where the researcher suggests that community members are more integrated with the province's main sources of economic income and therefore build strong social ties with

their neighbours, i.e. the spirit of Botho (Shutte 2001; Broodryk 2008). This can be explained as “motho ke motho ka batho ba bangwe” in sePedi: I am a person through other persons (Broodryk, 2008:41).

Botho is widely defined as being human and the value of the community above oneself. It is an African word for a universal concept of respecting each other, honesty, trustworthy and serving people in the spirit of mutual trust. Communal responsibility is key and natural resources are shared for generations to come (Gade, 2011). People are people through other people, embodies the principles Botho by acknowledging the rights and responsibilities of every citizen (South African Government Gazette, 1996).

No attempt is made to explain the reasoning for village placement with uses of water for cultural purposes, as Limpopo is the province that lies between the two extremes (furthest to water and closest). (This will be discussed in the next section, 5.3.2).

5.3.2 KwaZulu Natal (KZN)

This province is commonly referred to as the garden province and is a lush region with well-watered valleys. In between the mountains and coastline, there is savannah grassland as well as indigenous forest. The province has many rivers of which its largest is the Thukela. The climate ranges from typical subtropical summer rain along the coast to temperate with occasional heavy snow in the mountains, while the intermediate „Midlands“ area tends to remain cold in winter (Mucina and Rutherford, 2006).

It is the third smallest province, representing 7.7% of South Africa’s land. The population is, however, the second largest, with 10.3 million people with a rich culture whose principal language is isiZulu (Stats SA, 2011).

South Africa’s best-protected indigenous forests and game parks are found along the coastline, with some particularly rich in wildlife, including the „Big Five“. KZN has notably less land area available per person compared to the other provinces considered here, thus

the population appears to be inclined to have villages placed closer to each other. This optimises their distribution based on space constraints, however distances between houses within the Vongunzana village are substantial (Ashley and Roe, 2001).

In KZN, Vongunzana depicts a mean distance of 2325.62 in comparison to Dinsi and Sangweyana Estate, at 229.41 and 198.99, respectively. Upon further investigation, the researcher established, with the aid of Google Earth™, that the area of Vongunzana is characterised by rocky terrain that makes it difficult to build closer to water sources. This is an exception in KZN and may have led to the data being skewed in this regard.

Looking at the data for KZN, Dinsi and Sangweyana Estate depict a mean distance of 262.75 and 198.99 respectively. If the mean of this were taken to represent a more accurate distance in KZN for village X, it would be 230.87. This would average a distance of 692.61 for the province of KZN, maintaining it as the province that builds the closest to water sources.

The expectation of culture influencing the establishment of villages in relation to water may be proven if the above scenario is taken into consideration. The researcher suggests that water is used for the obvious reasons of drinking, washing, and cooking, but also for culture and religion, which for rural Africans especially play an enormously important part in their lives (Le-Meur and Blundo, 2009).

Watering holes are also purposefully kept at a distance from homes; this is mainly to prevent the disturbance of game in the areas on which rural communities rely. Furthermore, the distance is a root culture for woman and children whereby they learn to balance large quantities of water on their heads.

There is a very close relationship between water and culture in rural KZN, and almost every activity requires water in Zulu tradition, making it integral aspect that is well-respected (Le-Meur and Blundo, 2009). Zulu people understand changing weather patterns and maintain in-depth knowledge passed on from their ancestors. Elders organise uNomkhubulwane (Zulu „Princess of Rain“) ceremonies when anomalies are predicted (Ashforth, 2005). Ceremonies that are performed more frequently also depend on the proximity of water, for

example, flowing water is used as a healing and cleansing agent. Water is also used for the expulsion of evil and illness to detract the dark cloud that surrounds the person; this procedure is referred to as “isimnyama” in isiZulu (Zenani and Mistri, 2005).

Many other African traditions maintain that the ancestors’ spirits are to be found in or near water, and as such they pray at water sources regularly (Le-Meur and Blundo, 2009). Numerous traditional African and Christian denominations present in the province perform initiation ceremonies in the form of baptisms, and for this water is needed. Preferred sites for this include, but are not limited to, dams, rivers, lakes and streams (Zenani and Mistri, 2005). In some instances pools are built which are nourished by fresh water springs. Another example, the Nazareth Church in KwaZulu Natal, uses a pool to baptise its members. This is viewed as a sacred feature in this particular Zulu tradition. Baptisms can be performed by the pouring of water on the head three times, affusion, or water being sprinkled over the head, known as aspersion. In the Christian tradition, water is symbolised as significant because it is known as “the living water”, because this is the spirit of God and eternal life (Faelli, 2006). Traditional healers in several African traditions are initiated by having to spend a few days by a river or stream whilst becoming acquainted with the river spirits. Here they will constantly soak in the stream or river (Zenani and Mistri, 2005).

The way such traditions affect the placement of households in relation to water is complex, and much more detail in the geographic distribution of such traditions would be necessary to be able to explain the patterns observed within the province.

5.3.3 Eastern Cape

Rugged cliffs, natural beauty, dense green bush and rough seas characterise the Eastern Cape. The climate in parts of this province can be desolate. The province is the second largest province in the country, making up 13.9% of land in South Africa. It is home to 6.5 million people who predominantly speak isiXhosa (Stats SA, 2011).

Due to the long curved coastline and large area, the province has varied vegetation and there are numerous plant species endemic to the Eastern Cape. The interior of the province

is dominated by grasslands, whilst the western parts have savannah bushveld areas. The inland northern part is dominated by arid Karoo habitats (Mucina and Rutherford, 2006).

The Eastern Cape settlements sampled here were furthest from water sources. The villages of Mdakeni and Matshona have relatively similar average means, while Ntaboduli has more than double the former's average mean. With the assistance of Google Earth™, this deviation was seen to be attributed to the very steep slope that this village is located on separating it from water resources, as opposed to the other two villages which are located on moderately flat ground (Eastern Cape Provincial Spatial Development Plan, 2010). Moreover, Ntaboduli lies in the interior parts of the province in one of the areas dominated by grassland, therefore rondavel homesteads (the traditional Xhosa houses) have plenty of space to be erected.

Cultural sites include water bodies such as estuaries and river pools, which lie within ihlathi lesiXhosa (Xhosa Forest). These sites are of particular interest to the Xhosa as izinyanya (ancestors) mentor, guide and protect the village (Cocks, 2003).

The researcher's suggestion that substantiates the reasoning for the erection of these villages may be brought under scrutiny considering the similarities between these two cultures of the Zulus and Xhosas, as both belong to the broader Nguni group. However this can be justified in saying, although such traditions require water to be close to the inhabited areas, such ceremonies are not particularly frequent, and the trip to the water can represent a symbolic journey in itself. Moreover, in the Eastern Cape rural areas are geologically positioned, scattered above flood plains and on top of hilltops. This is mainly to avert diseases from water bodies and humid climates (The Eastern Cape Economic Profile and Outlook, 2010).

Notwithstanding the above-mentioned cultural uses of water, the fetching of water is more than it seems; it involves the transformation of a girl into a woman and freedom. Women are able to laugh, joke and talk loudly with each other, which they are not allowed to do in the village amongst men. Men usually use the river for bathing but also to talk about sport and for recreation and stick fighting, which can be used to justify the distance to travel to

access water (Zenani and Mistri, 2005). Cognisance of this would have to be taken into account for the erection of villages.

Moreover, research into this province identified specific plant species for religious purposes. This study shows that amongst the Xhosa people, wild plants are essential for cultural and religious practices (Leibbrandt, Woolard and Woolard, 2000; Cocks and Wiersum, 2003; Cocks *et al.*, 2008). The preferred landscapes of these villages are therefore plant species, vegetation structure, safety, availability of resources, as well as cultural and religious significance. “Ihlathi lesiXhosa” (Xhosa forests) are densely vegetated areas in the EC.

From the above it is evident that in KZN houses will be built closer to water resources owing to the immense cultural uses of water, while the Xhosa of the Eastern Cape potentially value natural vegetation for fuel and medicine more. It can thus be expected that Xhosa people would establish their villages closer to a forest, which is often placed on steeper terrain and water sources will be secondary to vegetation, as opposed to the situation in KZN. These patterns partly confirm the findings of this research, although much more detail than provided here would be needed to fully justify this line of thought.

5.3.4 Conclusion

Besides its practical function, water plays an integral role in all religious and cultural beliefs in South Africa. Cultural and religious values have been assigned to water for centuries by indigenous people. For many rural communities, water is linked to both physical and spiritual well-being; it forms part of many religious rites and cultural ceremonies in SA. Traditional management can assist in determining norms for sustainability and allocation (Harshfield and Jemec, 2010).

Mean distance differences were significant amongst villages within provinces, but also amongst all villages, which is largely attributed to the villages of Natoboduli and Vongunzana in the Eastern Cape and KZN, respectively.

5.4 Linking distance and income

The inverse relationship, although not significant, indicates that as distance increases, income decreases which can be linked to the amount of time spent collecting water. The researcher suggests that the more time spent having to collect water equates to less time villagers have to earn a living. Time is spent travelling vast distances with heavy containers, which inhibits household members from finding jobs and improving their quality of life. Moreover, the distance to water affects other social issues such as gender, as women are usually burdened with the collection of water, inevitably affecting their education. Strain is then placed on public hospitals, as more people suffer from illnesses caused by carrying heavy loads and walking long distances. In cases where water carriers are also under temporary employment, this leads to more days absent from work, diminishing the local economy and the South African GDP (UNESCO, 2009).

5.5 Conclusion

The results showed significant differences in distance to water, as well as in income, between provinces and the villages within these. They also indicated overall decreasing income values with increasing distance from water, although in this case the relationship was not significant. Differences between any two villages, whether in the same province or not, may have to do with the local environment – hydrology, geomorphology etc. Province-level differences, and to a lesser extent differences within provinces, can also be influenced by cultural factors.

African people across cultures have always maintained a link between land and water. Water in this regard is viewed not solely for consumption, but as part of a sacred life process (Le-Meur and Blundo, 2009). This chapter has attempted to bridge the information gap in this respect by briefly detailing the common uses of water for religious and cultural purposes, and alluded to this being determinants of how far villages might be built from water resources.

The Xhosa communities and culture build furthest away from water and have the least amount of income in the Eastern Cape. The results for the Eastern Cape and Limpopo are somewhat surprising considering the immense uses of water in cultural rituals for villagers in the different provinces, however justifications were provided for this. The Zulus settle the nearest to water and have the greatest mean income. The results of this study clearly show that natural landscapes and their associated biodiversity are closely linked to strong, nature-based religious beliefs.

This chapter looked at the results and interpretation thereof. It included a discussion on the two variables, being income and distance. The following chapter will make recommendations before concluding the research.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter will include sections that will link the objectives with the findings and bring the research to a close. It illustrates the contributions the research has made to scholarship and suggests recommendations to solve the research problem, as well as recommendations for future studies by noting the limitations experienced by the researcher.

6.2 Implications of this research

The research identified patterns in household distribution in relation to water, which will be imperative for future research. More importantly, the inverse relationship found between income and distance to water indicates that as distance increases, income decreases and can be correlated to the amount of time spent collecting water.

Moreover, the distance of water affects other social issues such as gender, as women are usually burdened with the collection of water, inevitably affecting their education. Strain is then placed on public hospitals, as more people will suffer from illness caused by heavy loads and long distances.

Lastly, discrepancies in distance were found within and amongst provinces. The researcher cited terrain, cultures and religion as possible justifications for this.

6.3 Recommendations to solve the research problem

Clean potable water systems should be implemented and maintained to ensure consistency of water and accessibility of taps. Ideally, private connections should be installed as close to homes as possible, with at least one tap per unit. The first initiative should be communal taps and the Water Research Council (WRC) should conduct social cost-benefits analyses of communal taps as opposed to the use of water from river sources and alike, although the

results would be obvious as communal taps will ensure cleaner water and smaller containers which will be less onerous to carry, and more economical concerning acquisition costs.

However, if people were to continue the practice of drawing water from rivers due to poor service delivery, they should at least be educated on hygiene, proper purification and maintenance of water containers, as well as the ergonomics of carry containers. Container technology will also need to be studied in detail and subsidies granted to acquire such technologies.

Poverty reduction and socioeconomic growth requires the development of water resource management. Programmes fail to acknowledge cultural and religious factors as paramount to water management. Growing awareness around this topic has become apparent and should be explored; in doing so, practices, values, beliefs and attitudes will be useful to study for water management systems. Specific landscapes should be designated for cultural purposes such as initiation sites. These sites should be managed by local government to foster cultural distinctiveness and maintain connections to the land.

Integrated management pays cognisance to water resource management and cultural and religious values. This framework should be explored by government as it is deemed necessary for conservation. The department can use this as an opportunity to foster relationships between themselves and the community, however this framework is poorly understood in South Africa. Appropriately applied this could establish approaches that are sustainable for future water initiatives.

Ultimately, economic deficiencies occur due to a lack of access to water. Proper service delivery will improve this by investing in water infrastructure for rural villages in South Africa.

6.4 Limitations

This is a first attempt at linking the two variables of water and income. As such, the researcher utilised easily accessible data for both – the 30 houses closest to water using Google Earth™ and the percentage population in the various income categories for 2011, rather than full income data.

The research took the form of a desktop study, therefore the researcher utilised secondary data. Data may have been incorrect and dated, however every attempt was made to use the most recent research available. Moreover, the latest version of Google Earth™ was used. Average income values were solicited from a Statistics South Africa official, which ensured integrity and the use of the most recent data. The abovementioned method was the most suitable method owing to the time constraints placed on the researcher, this being one year. All attempts were taken by the researcher to mitigate these limitations.

The cultural aspects brought into the discussion are in no way quantified in the study, and although there is no doubt in the researcher's mind that they are at least partly relevant to the results, this would also need to be properly investigated and quantified.

6.5 Recommendations for future studies

This study did not consider all the provinces in South Africa, therefore the South African population cannot be characterised as such. The next logical step to this study would entail more in-depth research with the use of primary data. This would mean having to collect average income per household as well as accurately ascertain each household's preferred water source. For example, household A may prefer water from a different point in the river as opposed to household B. This could be done by visiting the sample population and administering questionnaires or holding focus groups. Moreover, a wider variety of provinces should be sampled.

This study only focused on the income aspect of water and other areas of adequate water supply might be useful to study, such as gender, education, health and environmental concerns, as mentioned in chapter 2. Gender, health and poverty reduction are particularly essential for sustainable development and more emphasis should be placed on this.

6.6 Conclusion

The aim of this research was to establish if there is a relationship between the distances from households to running or standing water bodies and income in rural South Africa. The results have shown an inverse relationship, indicating overall decreasing income values with increasing distance from water, although in this case the relationship was not significant.

This study has mentioned the substantial economic deficiencies that occur due to the lack of access to water. Proper delivery services will improve this by investing in water infrastructure for rural villages in South Africa.

This study is not a definitive analysis of water issues and income on a countrywide scale, and the results are by no means put forward as being a total and accurate assessment. Nevertheless, it may be used as a plausible indication of what could be expected from similar situations elsewhere in the country.

Cultures and beliefs directly affect water management therefore, it is hoped that other researchers and the Water Research Commission will refine the methods used in this study to increase the results resolutions, so as to add to the existing body of knowledge. This study was not intended to be the ultimate research on this topic as it is a growing concern not only in South Africa, but globally.

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8. APPENDICES

8.1 Villages' distance to water arranged from nearest-to-water to furthest

