DOMESTIC WATER USE AND CONSERVATION PRACTICES AMONG THE HOUSEHOLDS OF KANSENSHI AND NDEKE RESIDENTIAL AREAS OF NDOLA CITY IN ZAMBIA

By

Vwambanji Namuwelu

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DECLARATION

I, **VWAMBANJI NAMUWELU (2015131154),** do hereby declare that this dissertation is my own work to the best of my knowledge and that it has never been produced or submitted for any degree, diploma or other qualification at the University of Zambia or indeed any other university for academic purposes. I further declare that all other works of people used in this research have been duly acknowledged.

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CERTIFICATE OF APPROVAL

This dissertation by **VWAMBANJI NAMUWELU** has been approved as fulfilling the partial requirements for the award of Master's of Science Degree in Environmental and Natural Resources Management by the University of Zambia.

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Examiner 1	Signature	Date
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ABSTRACT

As cities continue to grow so does demand for water increase among the various users. Understanding domestic water use practices can help to develop water conservation strategies, thereby contributing to efficient management of the water resource. The aim of this study was to examine the domestic water use practices of the households of Kansenshi and Ndeke residential areas of Ndola City in Zambia. A Cross Sectional non-experimental descriptive research design was used. Both qualitative and quantitative approaches were employed. Qualitative data was collected from the purposively selected key informant from Kafubu Water and Sewerage Company, Water Resources Management Authority (WARMA) and National Water Supply and Sanitation Council (NWASCO) using a semi-structured interview schedule. Quantitative data was collected using a structured questionnaire that was administered to the households. Field observations were also employed. For Ndeke the sampling frame was 105 while the sample size was 82. For Kansenshi the sampling frame was 62 and the sample size was 56. Systematic random sampling was used to select the households and quota sampling was used for determination of the study sites. Two sample Z- proportions test, Two- Independent Sample T-Test and Single Variable Analysis was used to analyse quantitative data while qualitative data was analysed by Content Analysis. Results revealed statistically significant differences in the proportion of respondents practising the following methods; bath tub use ($p=0.004$) and bucket use ($p=0.007$) for body wash, cup use ($p=0.0001$) and tap use (0.0001) for teeth brushing, sprinkler ($p= 0.042$) and hosepipe ($p= 0.022$) use for garden watering and basin ($p=0.002$) and tap ($p=0.002$) use for dish washing. There was no statistically significant difference ($p=0.989$) in the proportion of respondents who accessed water from Kafubu Water and Sewerage Company in the two areas. However the level of community awareness on water conservation was higher in Kansenshi than in Ndeke ($p=0.002$). Two Independent Sample T- Tests indicated that average combined income was higher in Kansenshi than in Ndeke ($p= 0.0001$) and that monthly payments for water were higher in Kansenshi ($p=0.001$). Domestic water use practices promoted water conservation as most respondents turned off the taps when not in use and advised members of their households to close the taps when not in use. There were several drivers behind domestic water use practices, these ranged from common practice that became sought of a tradition, comfort and enjoyment, saving measures in terms of water and bills, household fixtures, preferences in terms of which practice was easiest, fast, convenient, efficient and effective, hygiene benefits and weather conditions. This study proposes that as demand for water in cities increase, water resources management strategies can focus on improving adoption of household water conservation practices by residents. Understanding the prevailing water use practices and the drivers behind these practices can aid in developing appropriate domestic water conservation strategies and improve water efficiency. Water conservation measures during dish washing, brushing of teeth, garden watering and bathing must be intensified in high cost areas and focus must also be made on educating communities on the environmental benefits of water conservation.

KEYWORDS: Water conservation, water source and water availability.

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DEDICATION

To my parents, Mr Bernard Simuwelu and Mrs Selina Nangoyi Simuwelu and to my husband Mr Aaron Mpembamoto who through the years have encouraged me to work hard, pursue my dreams and always remain true to myself and my passion. I owe all that I am to them. I also dedicate this work to my God, for giving me strength and wisdom.

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ABBRIEVIATIONS

CBD	Central Business District
CSE	Centre of Science and Environment
CSO	Central Statistics Office
CUs	Commercial Utilities
DHID Development	Department of Housing and Infrastructure
DISS	Department of Infrastructure and Support Services
DWA	Department of Water Affairs
EIAs	Environmental Impact Assessments
GIZ	German International in Zambia
GRZ	Government of the Republic of Zambia
KWSC	Kafubu Water and Sewerage Company
LAs	Local Authorities
LWSC	Lusaka Water and Sewerage Company
L/p/d	Litre per Day
MEWD	Ministry of Energy and Water Development
MLGH	Ministry of Local Government and Housing
MWDSEP	Ministry of Water Development, Sanitation and Environmental Protection
NGOs	Non- Governmental Organisations
NWASCO	National Water Supply and Sanitation Council
OECD Development	Organisation for Economic Cooperation and
QDA	Qualitative Data Analysis
SPSS	Statistical Package for Social Sciences
TV	Television
UK	United Kingdoms
USA	United States of America
WARMA	Water Resources Management Authority
WASH	Water, Sanitation and Hygiene

WMD	Water Management Device
WSS	Water Supply and Sanitation
ZAFFICO Limited	Zambia Forestry and Forest Industries Cooperation
ZEMA	Zambia Environmental Management Agency
ZMW	Zambia Kwacha (Zambia Currency)

CHAPTER ONE: INTRODUCTION

1.1 Introduction

This chapter introduces the research problem. The chapter begins by first giving a background on water scarcity and why it is important to understand domestic water use practices in water resources management. It then bring out the statement of the problem, aim, objectives, research questions, hypotheses, the significance of the study , scope of the study and finally the organisation of the study.

1.2 Background

Most African and Third World countries face the problem of water scarcity. According to Naik (2016) at least 25 percent of the countries in Africa are already experiencing water pressure. Another eleven (11) countries are expected to join them by 2025 at which time nearly 50 percent of Africa's predicted population of 1.45 billion people will face water scarcity. This means that provision of potable water to consumers will be a serious challenge, hence the need for implementation of water conservation strategies.

Urban cities house a growing number of the world's population and water demand in these cities grows day by day. It is estimated that within the next 30 years there will be a 50 percent increase in urban water demand. Many cities, countries and regions around the world are faced with a trifecta of pressures: rapid urban population growth, economic expansion and competing demand, these cause the issue of water scarcity management to be a great challenge (World Bank, 2017). In addition, other factors such as pollution, suboptimal water management practices and climate change are negatively impacting the health of urban water systems, hence the need to come up with sustainable water management strategies for the urban setup (World Bank, 2017).

Zambia has not been spared from the problem of water scarcity. According to (NWASCO, 2016), the effects of climate change in Zambia has resulted into reduced water inflows in several area including Chongwe, Choma, Mwense, Zimba and Gwembe Districts.

In order to ensure sustainability of the water resource, providers of potable water to households and businesses must employ conservation strategies. Consumers of water must also take up the challenge of conserving water. Strategies for achieving these

goals include the development of alternative water sources, water recycling, and reducing consumption (Water Corporation of Western Australia, 2009).
There are various uses of water at household level. These include drinking, preparation of food, washing clothes and dishes, ablution use, watering the yard and gardens and washing pets and cars. These activities or practices can be analysed to explain water use and so inform decision making for water providers and consumers on water demand management (Pullinger, *et al.*, 2013).

The provider of water for Ndola City is the Kafubu Water and Sewerage Company (KWSC). The Kafubu River is the major water supply source for the city. KWSC has both ground water and surface water sources. The ground water sources are the Minsundu boreholes, while the surface water sources are the Itawa and Kafubu dams (GRZ, 2013).

The city of Ndola is growing at a fast rate, with the population increasing from 374, 757 in the year 2000 to 451, 246 in the year 2010, a projected population of 574,437 people in 2019 (CSO,2013). The city has an average annual population growth rate of 2.0 percent (CSO, 2013). Meeting water demands for this fast growing population is a challenge for KWSC. Furthermore, water security in the city is being threatened by factors like poor urban planning that has seen the depletion of aquifer recharge zones like the Itawa Swamps and the Kafubu River Buffer Zones that play a major role in regulating micro- climates and the water cycle process (GRZ, 2013). This has negatively impacted water supply in the district.

Demand for water is constituted through multiple related activities or practices. Analysing these practices by closely looking at what people do when carrying out these activities, how these activities are done and what technology and infrastructure is used when conducting these activities can help understand how these daily practices shape everyday water demand and consumption in the households (Shove, 2003). This study aimed at examining the water use practices of the households of Kansenshi and Ndeke residential areas of Ndola city in Zambia. The water use practices investigated included; bathing, brushing of teeth, laundry, dish washing, garden watering and car washing.

1.3 Problem Statement

Ideally every person is supposed to have access to adequate clean and safe water supply. However according to Liddle (2014) some residents in Ndola were leaving without water for days. Literature review has shown that this could be attributed to lack of or inadequate water conservation strategies when conducting domestic water use practices among other reasons.

Preliminary literature review also revealed that while studies have been conducted on water conservation in Zambia, no study was found specifically focusing on examining domestic water use practices in Ndeke and Kanseshi, hence the need to carry out this study.

1.4 Aim

The aim of this study was to examine the domestic water use practices of the households of Kansenshi and Ndeke residential areas of Ndola city in Zambia.

1.5 Specific Objectives

i. To determine which domestic water use practices are more prevalent in Ndeke and Kansenshi residential areas of Ndola.
ii. To assess how domestic water use practices relate to water conservation at household level.
iii. To identify the drivers of the various domestic water use practices.

1.6 Research Questions

i. What type of domestic water use practices are being employed in Ndeke and Kansenshi residential areas of Ndola?
ii. Do households practice water conservation in their daily use of water?
iii. What are the determinants of the various domestic water use practices ?

1.7 Research Hypotheses

i. There is a statistically significant difference in the prevalence of domestic water use practices (i.e.bucket use, bath tub use,shower use e.t.c) in Ndeke and Kansenshi.
ii. The proportion of respondents accessing water from Kafubu Water and Sewerage Company in Ndeke is statistically significantly less than in Kansenshi.
iii. Mean household income in Kansenshi is higher than in Ndeke.

iv. Payment of monthly water bills is statistically significantly higher for the residents of Kansenshi than that of the Ndeke residents.

v. The level of awareness on water conservation is statistically significantly lower in Ndeke than in Kansenshi.

1.8 Significance of the Study

The City of Ndola is growing at a fast rate, with the population increasing from 374, 757 in 2000 to 451, 246 in the year 2010 and an estimated population of 574,437 people in 2019 (CSO, 2013). This increase in population means an increase in water demand (Shan *et al*., 2015). Further, very little is known on water use pratices as evidenced from the scanty literature on this issue. This study therefore, is important because understanding domestic water use practices may help all the players in the water sector such as the Water Utility Companies, Councils, Non- Governmental Organisations and government departments to design sensitisation and behavioural change programmes towards improvement of household water efficiency and promote sustainability through reduction in water wastage. The local government, water utility companies, and all other stakeholders in the water sector may use the findings of this study to inform decision making towards sustainable use of the water resource. The households may also use the information to manage water consumption and reduce water bills.

1.9 Organisation of the Dissertation

This dissertation is divided into six (6) chapters. The first chapter is the introduction which gives a background of the study, the problem statement, aim, objectives, research questions, hypotheses, significance of the study, scope of the study and the study limitations. The second chapter is the literature review. This chapter brings out the reviewed literature on water scarcity and demand management strategies that are being implemented at global level, water scarcity challenges and mitigation measures in Africa, water use and the water situation in Zambia and Zambia's water reforms, drivers affecting domestic water demand, the theoretical framework and the lessons drawn from the literature that was reviewed. The third chapter is the description of the study area. The chapter discusses the geographical and social economic features of Ndola city, the location and demographic characteristics of Ndola while the last part brings out the description of the two study sites in terms of location, boundary of the

study area, population and water supply. The fourth chapter is the research methodology. This chapter describes the research design that was employed in the study, the sampling procedures, data collection tools and methods, the data analysis techniques, ethical considerations and data validity and reliability. The fifth chapter is the results and discussion. This chapter reports the research findings and the discussion in relation to the study objectives and the theoretical framework. The sixth and last chapter is the conclusion and recommendation of the study based on the findings of the research.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This literature review has been arranged into four (4) parts. The first part discusses the global water situation and the global water use practices and water conservation strategies. The second part discusses water conservation and water use practices in Africa. The third part discusses the water reforms, water situation, and water use practices in Zambia and the forth part discusses the theoretical framework and the lessons learnt from the literature reviewed.

2.2 The Global Water Situation

Water is a foundation of life and livelihoods, and it is key for sustainable development (Guppy and Anderson, 2017). Thus, successful water management can serve as a foundation for the achievement of many of the 17 Sustainable Development Goals (SDGs), more specially SDG 6, which is to 'ensure availability and sustainable management of water and sanitation for all', (United Nations Development Programme, 2017). However, water is becoming a pressing societal issue as it is projected that 40 percent of the world's population will be living in seriously water-stressed areas by 2035 and that the ability of ecosystems to provide fresh water supplies will become increasingly compromised (Guppy and Anderson, 2017). It is also estimated that there will be a 40 percent gap between water demand and water available by 2023 and that 30 percent of the global water abstraction is lost through leakages (Guppy and Anderson, 2017).

The notion that water is plentiful and covers 70 percent of the planet is false, as only 2.5 percent of all water is freshwater (Kummu, *et al*., 2016). This limited resource will need to support a projected population of 9.7 billion in 2050; and by that date, an estimated 3.9 billion or over 40 percent of the world's population will live in severely water-stressed river basins (Kummu, *et al.,* 2016). It is not just population that is pressuring water resources, excessive use is also evident. The global population tripled in the 20th century, but the use of water increased six-fold (Kummu, *et al*., 2016). Between now and 2050, water demand is expected to increase by 400 percent from manufacturing, and by 130 percent from household use. Water insecurity is also exacerbated by drought, more people are affected by drought than any other disaster

type (Guppy and Anderson, 2017). In 2016, 411 million people in total were affected by disasters and 94 percent of those were drought affected (Guppy and Anderson, 2017).

Global statistics also state that there has been a drop in global available fresh water per capita of 55 percent since 1960 and that by 2030 global demand for water is expected to increase by 50 percent (Kummu, *et al., 2016*) It is also said that currently water scarcity affects more than 40 percent of the global population and that by 2030, an additional 2.3 billion people can be expected to be living in areas with severe water stress especially in North and South Africa and South and Central Asia. Again it is said that for each degree of global warming, approximately 7 percent of the global population will be exposed to a decrease of renewable water resources of at least 20 percent (Guppy and Anderson, 2017).

Given the global statistics it can be argued that water is a very dynamic resource that is bound to be affected by social and environmental factors, hence the need for sustainable management of the resource.

2.3 Global Methods of Water Conservation

Water conservation is any action that reduces the amount of water withdrawn from water supply sources, reduces consumptive use, reduces loss or waste of water, improves efficiency of water use, increases recycling and reuse of water, or prevents pollution of water (Rohilla *et al.*, 2017). Water conservation involves two distinct areas, technical and human. The technical side includes collecting data from water audits and the human side involves changing behaviours and expectations about water use and the way things should be done. Both areas must be addressed for a water conservation programme to succeed (Kumari and Singh, 2016).

There are various methods that are used globally in water conservation. These methods can be divided into the following two categories:

(i) conservation at the source of water supply; and

(ii) Conservation from the demand side.

Methods of water conservation from the source of water supply include, catchment management and in situ treatment for the lakes, flood plain restoration and pollution abetment for the rivers and maintenance of water balance, mapping ground water,

ground water recharge and restricting informal ground water extraction for underground water (Baumann *et al*., 1980).

From the demand perspective, conservation methods include; use of efficient fixtures for untapped and excessive flow of water, use of treated waste water for flushing, metering and water pricing for non-revenue water, operations and maintenance to reduce losses through leakages, reuse for bulk uses such as horticulture, road washing and construction activities and rain harvesting for uncontained rainwater runoff (Center of Science and Environment, 2016). With increasing demand on water resources these water conservation methods can be promoted at household level to enhance sustainability in the manner in which water is used.

Education and public awareness are also an integral aspect of demand management, because they have the potential to alter behaviour on a mass-scale to save water. The best practice initiatives are those able to engage the public as stakeholders and partners in the project of saving water. This is often achieved by setting concrete city-wide targets that the public aim for together, and enabling individuals to measure their personal consumption against the collective target (Rohilla *et al*., 2017). For example, public awareness campaigns were conducted in Zaragoza city in Spain, the campaigns aimed at broad public engagement in all sectors to gain commitment to the 'Water Saving City' theme. This programme was done in three phases, Phase one the 'Inspirational Phase' set the initial collective challenge and involved schools, businesses and households in initiatives to achieve it by informing users about water-saving technology and encouraging serious behavioural changes. Almost 70 percent of educational institutions in the city participated in the project (Bryx and Bromberg, 2009).

Good practices in technology and uses in gardens, public buildings and industries is also important in water conservation (Fleming and Hall, 2000). For example, cooling systems using recycled water, changing commercial cleaning routines, improving pipe/leak maintenance, water-recycling at carwashes, environmental education in schools, change in practices and technology upgrade at processing plant , municipal orders to save water, publishing detailed guides and self-assessment 'Eco-audits' aimed at different sectors (Kurunthachalam, 2014). These can help industries, schools

and homes to assist users in assessing and managing consumption efficiently (Bryx and Bromberg,2009).

Employing water restrictions can also contribute to water conservation (Martin, 2008). Water restrictions are mandatory or voluntary restrictions on the use of water, which are relative to water storage levels, as defined by drought response plans. An example may include an outdoor water-use restriction put into effect to restrict the outdoor use of water supplies often called a watering ban or hosepipe ban which can affect irrigation of lawns, car washing and recreational uses such as filling of swimming pools (Kurunthachalam, 2014).

Other measures that have been implemented around the world to ensure water conservation include: watering gardens 2 days only per week, between the hours of 6am and 8am in order to reduce evaporation loss and banning of Sprinkler systems and adopting automatic dripper systems that are used between midnight to 2.00am (Magiera *et al*., 2006). Other measures include; restricting watering of sports grounds, and reducing the quantity of water used on sports grounds (Bryx and Bromberg,2009). Commercial car washes could also be utilized only if they used less than 70L of water per car and installation of onsite water recycling technology at car washes and banning of hand-wash of cars by residents except for windows, mirrors and lights and finally seeking of permission before filling of pools or spa (Environmetal Services Department, 2014).

According to Vaidya *et al.*, (2013) introduction of sustainable building codes can improve water efficiency. Essentially the Codes mandate energy and water efficiency measures via a point system. They detail how the savings made through installation of particular devices is to be calculated, and the minimum scores required for building approval. The codes rate all water-using fixtures and appliances, as well as greywater recycling and rainwater harvesting systems (Dziegielewski,2003). For example, the United Kingdoms (UK) introduced a new building code entitled the 'Code for Sustainable Homes' in 2006. This was in order to promote water efficiency at household level (Bryx and Bromberg, 2009). Waterless toilets are also being adopted in ecological building designs resulting in water-savings of up to 40 percent (Koop *et al.*, 2019).

Appropriate pricing forms a key aspect of effective demand management (Cosgrove and Loucks, 2015). Best-practice domestic water pricing balances three key principles; cost recovery, incentive for efficiency, and equity. In Texas for example, the municipality has implemented water pricing to meet full cost recovery for infrastructure, delivery and treatment, and in theory pricing in Texas is supposed to meet the full cost recovery principle including resource and environment costs and the city has achieved low domestic water consumption levels in the United States of America (Texas Water Development Board, 2004). In another case, the pricing scheme in place in Zaragoza is recognized as best practice in terms of meeting the principles of equity, efficiency incentive and economic cost recovery. Water tariffs in Zaragoza apply to both supply and wastewater, and both include a nominal flat base rate plus a tiered variable rate (Bryx and Bromberg, 2009).

In another study conducted by Grech (2017) on Household Water Consumption in the Maltese Islands in Malta, whose aim was to identify the amounts and main uses of water among the Maltese households and the patterns of these uses, to recognise the difference between the perceived and actual amounts of household water consumption and to analyse the relationship between water consumption patterns and socio-economic and demographic characteristics of households, the study indicated that there was a significant trend towards the conservation of water and the reduction of water wastage in households. The households indicated that they employed various measures to conserve water. These measures included; avoiding small loads of laundry, using greywater for toilet flushing and repairing of dripping taps. Other popular measures included the use of water efficient showerheads and dual flushing systems, the use of tap aerators and flow control valves, and the use of well water.

Other measures that can be taken to reduce wastage of water among households include the use of pool covers for swimming pools and closing of taps when not in use (Kumari and Singh, 2016). Changing non-efficient showerheads to more efficient ones and switching from single flush toilets to toilets that are equipped with dual flush systems, installation of water efficient appliances and recycling water (Kurunthachalam,2014).

2.4 Causes and Effects of Water Scarcity and Coping Strategies in Africa

2.4.1 Causes of Water Scarcity in Africa

There are many causes of water scarcity in Africa, these include; lack of purification chemicals and aging, dilapidated and outlived equipment and huge maintenance costs (Chaminuka and Nyansanza, 2013). Minor Leakages and water bursts are also other causes and in Harare these were causing about 30 percent of water loss which was about 500 000 litres of waste water per year (Chigumira and Mujure, 2009). Other causes include power outages to water works which contribute to water scarcity as they disrupt water supply. Recurrent droughts also negatively affected the inflow of water in the rivers, lakes and dams thereby affecting negatively water supply (Mangizvo and Kapungu, 2010). Mukuhlani and Nyamupingidza (2014) also indicated that drought causes water scarcity by affecting the amount of rainfall and water in the rivers, streams, lakes and other reservoirs. Failure to harness and preserve available water, population growth and siltation of reservoirs are other causes of water scarcity in Africa. According to Musemwa, (2007), the city's population in Bulawayo had increased tremendously since the time that the dams were constructed in 1976 and hence had been in need of a new reservoir since 1986. Rural-urban migration and tremendous urbanisation had increased the population in Bulawayo thereby increasing further the demand for water in the city (Musemwa, 2007). Unfair distribution of water and illegal tap connections are also other causes of water scarcity (Machete, 2011). Parks *et al.,* (2019) also indicated high consumption and lack of investment in water supply capacity as being causes of water scarcity in Cape Town.

2.4.2 Effects of Water Scarcity in Africa

In Harare one of the major effects of water scarcity was that the residents had their normal daily routines such as laundry and bathing altered since they had to wait for long hours in order for water supply to be restored. Residents had to move long distances and hours in order to find alternative sources of water (Hove and Tirimboi, 2011). Musemwa (2008) also indicated that women had to wake up as early as 3 o'clock in the morning to queue up at the local boreholes. Water scarcity had also caused health effects in Bulawayo as it had directly and indirectly led to increase in water borne diseases (Mukuhlani and Nyamupingidza, 2014).

According to World Health Organisation, (2008) as of 1 December 2008, the Ministry of Health in Zimbabwe had reported a total of 11 735 cholera cases with 484 deaths since August 2008, affecting all provinces in the country. Hug (2009) also indicated that in Zimbabwe the children were the most affected by the water borne diseases as compared to adults. This had been attributed to the fact that children practiced poor Water Sanitation and Hygiene (WASH) practices compared to adults. The water shortages had also impacted negatively on the keeping of personal hygiene. Most people in the area forewent some basic chores such as bathing and washing clothes due to erratic supply of water (Hug, 2009).

Water scarcity in Bulawayo had also made basic sanitation to seem more of a luxury and a very stressful process. It had become more difficult for residents to use the toilet as there would be no water to flush. Most if not all toilets in Bulawayo used the flush type of latrine which depended on the availability of consistent water supply to properly function. The failure to have reliable water supply had forced residents to find alternative means of relieving themselves most of which were unhygienic. Water shortages had also exacerbated the occurrence of burst sewages in the area (Mutsvangwa, 2001). Failure to have water in the area had led to people using less water to flush. This had led to human waste pilling up within the sewer pipe which ended up leading to sewer bursts which had led to pollution in the area (Mutsvangwa, 2001).

Under the gender dimension a study in Tanzania by Mkonda (2015) noted that water scarcity had the capability of derailing the achievement of Millennium Development Goal 3 as the water shortages had increased the productive roles of women, as it had been mostly women who were responsible for fetching water and facing long queues waiting to get water during water rationing days. This disparity had been due to the fact that it was mostly women who were around at home for most of the time hence the duty to fetch water had rested with them. The research also noted that it was mostly school going children especially girls that were involved in fetching water hence negatively affecting the education of the children and mostly of the girl child. During water rationing many children especially the girl child missed the lessons as they had to spend long hours on queues fetching water. Other negative effects included increase in conflicts over water resources and also effects on the agricultural, construction and industrial sectors (Mkonda, 2015).

2.4.3 Water Scarcity Coping Strategies in Africa

Various coping strategies to water scarcity are being employed in Africa. These include; underground water such as boreholes and wells which was illegal in high density areas according to the Zimbabwean Water Act of 1998 (Baietti, Kingdom and Ginneken, 2006). Aroka (2010) indicated that rain harvesting was one of the strategies that was being implemented to cope with water scarcity in Kenya. He mentions that the residents were collecting rain water from the roof tops through the installation of tanks and other containers e.g. buckets and dishes, that collected the natural water which could then be used for domestic and other uses (Aroka, 2010).

Coping strategies to the effects of water scarcity in Zimbabwe included water rationing as a stop gap measure that was aimed at preserving water at the reservoirs between rainy seasons. The water rationing scheme had become somewhat of a permanent feature for the residents in Bulawayo. Water rationing had been effective in conserving water but had not been a solution. It was more of a crisis management initiative that aimed at alleviating water shortages especially in those areas that were on high ground which would not have had water unless water rationing was employed. Water levels in the reservoirs had stayed relatively on the 50 percent mark. Water inflows into the reservoirs had determined the levels of water in the reservoirs and water consumption had also played a role as it constituted the outflows. It had been the negative balance between inflows and outflows that had necessitated the water rationing (Musemwa, 2008).

The big flush was another initiative that was proposed by the city council in Bulawayo to deal with sewer blockages that were being caused by insufficient water being used to flush toilets. The idea was that at a particular time all residents should flush their toilets. The agreed time was 7 pm every day (Mangizvo and Kapungu, 2010). Also during the height of the water shortages, the City Council began transporting water to areas that were seriously affected by water shortages. This was done to ensure that more people get water. Schools and clinics were some critical areas that were prioritised by the City council in an effort to avert a health crisis (Bulawayo Water and Sewerage Programme (2011). Under the National Matabeleland Zambezi Water Project, the government had also embarked on dam construction projects that could help in mitigating the water crises in the city, one such project was the Gwayi Shangani Dam and the Mtshabezi Dam that were completed in 1994. Some NGOs like world

vision had also embarked on Water Sanitation and Hygiene (WASH) sensitisation measures (Chigumira and Mujere, 2009).

Still in Bulawayo on the part of the residents, they were forced prior to the rehabilitation of the boreholes to store water in buckets and other available containers as a water conservation measure and coping strategy during water shortages. Residents were also forced to engage in water conservation as they sparingly used water. Water reuse was also an effective response measure that was embraced by the residents. For example, bathing water was not thrown away but was kept to be used to flush the toilet (Mutsvangwa, 2001). The same was also done for laundry water used for rinsing clothes which was also recycled. This proved to be an effective mitigation method at household level. This lessened the burden of going to the borehole frequently. This water was used for domestic purposes such as bathing and laundry (Malesu *et al.*, 2007). Other measures included; procurement of new machinery and pipes for drawing water, water tanks and bore holes, usage of other reservoirs to augment the current one, equal distribution of water, minimizing watering of lawns, banning of household car wash water tanks and allocation of adequate budget for improvement of water infrastructure by the municipality (Machete, 2011). Parks *et al.,* (2019) also indicated demand management strategies being implemented in Cape Town. These included; Water restrictions which defined limits on how water is to be used, in what quantities and for which purposes. At the most extreme level of restriction, residents were restricted to a maximum of 50 litres (13.2 gallons) of water per person per day. Another measure to manage water demand in Cape Town was in tariff adjustments, tariffs were increased significantly from 2016 until late 2018 in order to reduce water demand and tariffs were not downgraded until October 2018. Another strategy employed in water demand management in Cape Town was the use of Water Management Devices. A Water Management Device (WMD) is an equipment that can be installed to a water supply pipe to enforce a set daily limit of water for a property. After the maximum withdrawal is reached for the day, the water is reduced to a trickle until the following day when service is resumed, (Department of Water and Sanitation, 2018). City-wide water pressure reductions were also employed to manage water demand. The reduction of water pressure through the city reduced overall consumption, decreased water loss through leaks, and resulted in a reduced frequency of pipe bursts and further leaks, (Fantozzi, 2015).

Communication strategies and behavioural change campaigns were also used as a water demand management strategy. These included extensive public relations campaign to encourage water saving through websites, Television (TV) and radio adverts, flyers in water bills and billboards doted all around Cape Town. These communication campaigns were successful in contributing to changing the social norms around water use in the city as many of the recommendations were widely adopted by residents (Enquist and Ziervogel, 2019). Mobile applications such as the Tap Off and Drop-Drop were also used in water demand management in Cape Town. Tap Off focused on intensifying the experience of water saving, by presenting users with leader boards to display low-consumption behaviour while Drop-Drop was developed as a research prototype by the University of Cape Town to test the impact of information on a household water consumption behaviour, and provide households with tools to track and visualise their water use (Champanis *et al.*, 2013).

2.5 Water Reforms in Zambia

Much of Zambia's drinking water infrastructure was built between independence in 1964 and the mid- 1970s, at this time, the economic growth for the country was very strong and export earnings from copper mining were high. Water was provided for free and sustainability of the services was not in any way accountable to the water users (GRZ, 2010). Water supply was the responsibility of the Local Authorities, with the exception of the mining belt where the state-owed copper company operated water systems for the settlements housing their employees (GRZ, 2010).

Between the 1970s and 1980s, Zambia considered establishing a National Water Authority responsible for water supply sanitation and water resources management, however those that preferred decentralised services prevailed and the proposal was shelved. There was no national strategy for the sector and the responsibility for the sector was fragmented among several ministries. Meanwhile, the infrastructure deteriorated, hand pumps in rural areas broke down, and urban systems provided water without disinfection on an intermittent basis. The few who had access to continuous water supply received it for free and wasted it, with consumption levels of 200 litres per capita per day, this was higher than most European cities. In terms of sanitation most of the sewer systems in the country did not have wastewater treatment plants, this time the water sector was operated under the Water Act of 1949, Chapter 198 of the Laws of Zambia, hence the need for the water sector reforms, (GRZ, 2010).

Zambia has been undergoing water sector reforms since the early 1990s. The main objective was to create new institutions which would be able to provide cost- effective and sustainable Water Supply and Sanitation services throughout Zambia. In 1994, The National Water Policy was adopted as a framework for future developments of the water sector. In order to implement the reforms in the policy, the seven sector principles outlined in the 1994 Water Policy were adopted, the principles included; Separation of water resources functions from Water Supply and Sanitation, Separation of regulatory and executive functions within the water supply and sanitation sector and devolution of authority to Local Authorities (LAs) and private enterprises (Liddle, 2014).

According to the National Water Supply and Sanitation Council (NWASCO, 2017) institutionally the water sector of Zambia draws its authority from the cabinet decision of 1994 in which NWASCO a regulatory body was to be established under the Ministry of Energy and Water Development (MEWD), the institutional setup for the sector became as follows;

- All water resources management functions became the responsibility of the Department of Water Affairs (DWA) under MEWD. While all functions relating to provision of water supply and sanitation services became the responsibility of the Local Authorities (LAs) under the supervision and support of the Ministry of Local Government and Housing (MLGH).
- Through commercialisation, the LAs outsourced the management of Water Supply and Sanitation (WSS) services to private enterprises formed by joint venture with other LAs called Commercial Utilities (CUs).
- Regulatory functions were given to NWASCO while executive functions were retained within the then MLGH.
- The department of infrastructure and Support Services (DISS) later renamed Department of Housing and Infrastructure Development (DHID) under the then MLGH coordinated interventions and mobilised resources for Water Supply and Sanitation (WSS).

In 1997, the Water Supply and Sanitation Act No. 28 was passed. The act established the regulator NWASCO and provided for the formation of CUs by the Local Authorities as either private or public companies (NWASCO, 2017). In 2010 the Water Policy was revised and led to the formulation of the Water Resources Management Act No. 11 of 2011. The 2010 water policy did not include water supply and sanitation hence the WSS Act No. 28 of 1997 is currently being revised to address the shortfalls in its administration and finally in 2017 a new Ministry of Water Development, Sanitation and Environmental Protection (MWDSEP) was established to preside over among others; Water Resources Management and Development, Water Supply and Sanitation, and Environmental Protection and Pollution Control Policies (NWASCO, 2017).

Institutional bodies under the Ministry are: NWASCO established to ensure efficient and sustainable water supply and sanitation service provision. Water Resources Management Authority (WARMA) established for management, development, conservation, protection and preservation of water resources and ecosystems. Zambia Environmental Management Agency (ZEMA) that sets standards and limits for environmental protection. CUs for water supply and sanitation service provision and the Environmental Protection Fund whose objective is to ensure that developers conduct Environmental Impact Assessments (EIAs) in accordance with the Environmental regulations (NWASCO, 2017).

2.6 The Water Situation in Zambia

According to NWASCO (2016) the recent experiences of partial droughts, drying of dams and boreholes has brought the realisation that full blown climate change effects and uncontrolled anthropogenic activities greatly threaten reliability and sustainability of water supplies in Zambia. In the past few years, the effects of climate change and variability in Zambia has resulted into reduced water inflow. In Chongwe for example under the LWSC, the dam supplying water to the town has been consistently drying up in the hot season resulting into constrained water supplies. In Choma district, the Blue Williams dam experienced reduced storage and deterioration in water quality causing threats to the town's water supplies. The river sources in Mwense district and the reservoirs in Zimba, Gwembe, Nyimba and Chipata have in recent years been drying up in the hot- dry season (NWASCO, 2016).

For Lusaka City, most boreholes both private and utility owned, have in the recent past experienced reduced yield to as low as zero, this caused the utility company to suspend operations of some boreholes thereby impacting water supply in some residential areas including Chelston, Avondale, Ibex Hill and George compound (NWASCO,2016). Strategies to combat water insecurity in Zambia that are suggested in the 2016 Water Supply Sanitation Sector Report include; mainstreaming of Climate Change by screening projects for climate change so that adoptive measures are incorporated at design stage to counter present and future anticipated risks; Multi-sectorial planning approach and enhanced collaboration i.e. the Lusaka Water Security Initiative; Increased investment towards water supply and sanitation and water resources management and advocacy and sensitization to instil a water wise culture (NWASCO,2016).

For the case of Ndola, water demand for the city has not only increased because of the increase in population and climate change effects. According to Liddle (2014) Infrastructural challenges due to insufficient investment in maintenance and expansion of public water utility services are responsible for the downfalls of KWSC supply and hinder water provisioning in Ndola. It was also indicated in NWASCO (2017) that most of the parts of Ndeke Township had extreme water supply challenges and that Ndola had major water infrastructure projects underway which necessitated water supply interruptions, hence the need for efficient water management strategies.

2.7 Domestic Water Use in Zambia

In Zambia water for domestic purposes is mainly used for drinking, cooking, washing, bathing and sanitation. In addition, water is used for subsistence gardening and support of domestic animals, subsistence fishing, the making of bricks, the dipping of domestic animals and firefighting (GRZ, 2010). Access to safe and adequate water supply is still low. The 2000 Census Report estimates average supply at 49.1 percent. Access has not increased significantly from this level. Accessibility in urban areas is estimated at 86.1 percent whilst in rural areas it stands at 29.5 percent. It is further estimated that domestic use per unit consumption rate in the urban areas is taken as 180 litres/capita/day for the larger urban areas (cities), 150/litres/capita/day for small urban areas (small towns) and 45 litres/capita/day for rural areas (GRZ 2010).

For rural areas the domestic use per unit consumption does not meet the recommended daily supply of 150 – 200 litres of water per capita, which is what is considered an adequate supply to meet the needs for all domestic purposes as indicated by (Park, 2007). Compared to other countries, Zambia's domestic water use per capita per day is lower than that of European and American cities and higher than in some areas of the developing world. As indicated in Gleick (2003) on average an American citizen consumes 425 litres per day. In Europe this quantity decreases to 237 litres per day in Italy and 150 in France. In some areas of the developing world, such as rural Madagascar, the quantity may fall to as low as 10 litres per day (Gleick, 2003).

2.8 Drivers of Domestic Water Demand

According to Jorgensen *et al.,* (2009), there are various drivers of domestic water use behaviours. These drivers are categorised into direct and indirect drivers. The direct divers include; climate and seasonal variations, incentives and disincentives, regulations and ordinances, property characteristics, household characteristics and person characteristics while indirect drivers included person characteristics, institutional trust, inter-personal trust, fairness, environmental values and conservation attitudes, intergenerational equity and socio-economic factors.

The exact drivers appear to be contextual and behaviour dependent particularly when comparing indoor (e.g., cooking, drinking, showering, laundry, toilets, etc.) to outdoor uses (e.g., garden irrigation, cleaning, swimming pool, etc.). Outdoor use is thought to be more discretionary when compared to indoor use and thus, it is often the first target for regulations through water use restrictions. Some of the drivers for indoor use include household composition, presence of water saving devices and a range of socio-economic factors. The main drivers for outdoor use include garden type and importance, regulations, social norms and lot size (Jorgensen *et al.*, 2009).

In another study by Manouseli *et a*l., (2017), there are several factors affecting domestic water demand. These factors are discussed below;

Water Price; the price of water is one of the factors that affect water consumption. Overall, below a certain volume of water consumption, demand is often found to be

unresponsive to price change making price manipulation an ineffective tool for demand control even were it socially acceptable (Manouseli *et al.*, 2017).

Household income; it was also indicated in (Manouseli *et al.*, 2017) that household income does affect domestic water demand and in general consumption is found to increase with affluence.

Mylopoulo *et al.*, (2004) also noted that household size was another key driver of water demand and due to economies of scale, average per capita consumption decreases as household size increases, this can be attributed to shared water-uses (e.g. cooking and garden watering) and there may be a household size threshold beyond which these economies of scale diminish, thus causing water consumption to be less than proportional to household size (Mylopoulos *et al.*, 2004). It is also generally accepted that the elderly tend to consume less water in their homes than younger people possibly due to young people's more water intensive habits, (Kenney *et al.*, 2008).

Apart from household or occupant 'attributes', local temperature and drought conditions have been shown to have a positive relationship with consumption, but there is an inverse relationship between consumption and precipitation, (Parker and Wilby, 2013). Garden size and landscaping type also significantly affect water consumption (Guhathakurta and Gober 2007); (Harlan *et al*., 2009); (House-Peters and Chang, 2011). However, in built up environments the effect is limited to the small proportion of households that have a garden and also use supplied water to irrigate it (Pullinger *et al*., 2013).

Climate affects domestic water demand and according to Cubillo and Ibanez (2003) climate is one of the most explicative drivers of domestic water consumption. Also domestic water consumption is supposed to vary depending on climate variables, especially temperature and rainfall (Gato *et al*, 2007) and according to Corbella and Pujol (2009) other variables such as moisture and irradiation may be relevant as well. Rainfall is also said to have an effect on outdoor activities, especially garden watering. In an urban environment, the precipitation regime will determine the water needs of the plants and the lawn that will have to be covered by network water (Cubillo and Ibáñez, 2003).

Temperature has also been shown to impact water consumption. The rationale is that hotter days bring about increased garden watering, swimming pool use, and personal

hygiene (Hoffmann *et al*., 2006). In other words, high temperatures imply on the one hand more evapotranspiration both from humans and plants, and this fact increases garden needs and human need to be hydrated. In addition, high temperatures could mean a higher degree of evaporation of water in swimming pools, with the subsequent need to fill them up more frequently (Griffin and Chang, 1990).

Corbella and Pujol (2009) also discussed economic drivers of water demand. They indicated that economic instruments, and especially price, were among the factors considered to influence domestic water demand. Interest in pricing and other economic instruments arise as part of a more general approach to water management emphasizing control actions over demand. Thus, demand management has been postulated as an alternative to the 20th century hydraulic paradigm (Anderson and Sprenger, 2000).

Under the ideological construct of the alleged supremacy of the market as the instrument to manage and efficiently allocate natural resources, price represents one of the most relevant tools to manage water demand (Garcia and Reynaud, 2004). Lux (2008) also linked the decreases of water consumption in East Germany after the unification to financial incentives (price increases) and technological changes.

At the institutional level, international organizations such as the Organisation for Economic Cooperation and Development (OECD) or the European Union, through the European Water Framework Directive, champion the application of market instruments to efficiently manage demand. The essential logic is that higher water prices lead to lower consumption (Shaw, 2005), when water is treated as a pure economic good. However, as Savenije (2002) notes that water is far from behaving as a normal economic resource as for most uses, water is irreplaceable. Most of economists working on domestic water generally recognize that domestic water consumption tends to be price-inelastic which means that the decrease in demand is lower than the increase in price. For domestic consumption price-elasticity oscillates between 0 and -1, and also may vary over time (Espey *et al.*, 1997). Scholars working with domestic water consumption models have proven that, in general, the price elasticity of water demand varies according to the use given (Billlings and Aghte 1980). The more basic and essential the use is, the closer to zero the price-elasticity of

this demand will be. As a result, price mechanisms would not make a great difference in the demand for those quantities of water (Billings and Aghte 1980). Conversely, when dealing with leisure activities such as watering the garden or making use of swimming pools, price-elasticity of the demand approaches -1. This information is critical to set pricing schemes in order to balance equity with efficiency and to achieve the greatest conservation potential in outdoor uses while not translating the conservation burden to essential uses (Corbella and Pujol, 2009).

According to Martinez-Espineire and Nauges (2004) in addition to the variation of elasticity that follows the use given to water, water demand function presents different elasticities for different levels of consumption in different price ranges. As a result a great deal of economic literature has specifically focused on water pricing schemes and several price mechanisms approached has been proposed, thus, moving from a uniform to an increasing block structure tariff can significantly impact demand (Whittington, 1992). It was also indicated in Gaudin *et al.,* (2001) that domestic water consumption is positively correlated with income. Income being a proxy of affluence, affects water consumption in different ways. On the one hand, higher levels of income may suppose an increase in living standards, which could imply a higher quantity of water-consuming appliances and a higher probability of the presence of high-water demanding outdoor uses such as lawn gardens and swimming pools (Cole, 2004). On the other hand, income importantly affects the responsiveness to price mechanism. Thus, while low income families may not respond to price because they are using water mostly to fulfil basic needs, well-off individuals or households fail to respond because the price signal is not strong enough to curb their consumption. This suggests that a conservation campaign based on price mechanisms may probably achieve larger reductions in domestic demand in lower income zones than in higher income communities (Renwick and Archibald, 1998).

Beal *et al.*, (2012) in his study on identifying the Drivers of Water Consumption conducted in South East Queensland discussed the Impacts of Household Socio-Demographics on Water Consumption. In their study, the findings indicated that higher income households consumed more water on average per day than lower income homes. The end uses that contributed most to the increased consumption were shower, clothes washer, dishwasher and bath. There was a trend for households with

small families, with an older average age of residents and no children to consume less water per household on average. Typically, water consumption was higher for large homes with large families as the demand for water was obviously greater and there are a higher number of water fixtures and appliances. However, larger families were typically more water efficient on a per capita basis than single families (Beal *et al.,* 2012).

In another study by Beal *et al*., (2011), it was indicated that homes with one or more teenagers consumed significantly more water for shower events compared to homes without teenagers. In terms of perceived water use clusters, a clear pattern emerged from the results which showed that self-reported high water users typically consumed less (130 L/p/d) than both the self-reported medium (156 L/p/d) and low (143 L/p/d) water users on a per capita basis. It was also indicated in Beal *et al*., (2012) that higher income, larger, younger and more educated households tend to install efficiency appliances which may not always be sufficient in reducing water consumption if curtailment actions are not present and hence according to Beal *et al.,* (2012), both water consumption behaviours, as well as technology need to be considered as part of a successful demand management strategy.

2.9 Theoretical Framework

Attempts to promote conservation in the environmental sector have traditionally been loosely based around two broad 'models' or patterns of human behaviour (MacKenzie-Mohr *et al*. 1995; Rolls 2001). The first is the rational-economic model (also known as the rational choice model). This states that, to influence conservation based decisions, a consumer requires only information relating to financial and performance advantages of alternative choices to enable them to act accordingly. The second is the attitude-behaviour model, which is based around the idea that an individual's behaviour is determined by their attitude towards a particular issue, such as conservation, and that their behaviours can be changed by influencing their attitudes (Triandis 1977). This study however used the theory of Interpersonal Behaviour to analyse the water use practices among the households in the study areas. Unlike the Attitude-Behaviour Model and the Rational Choice Model, Triandis' Theory of Interpersonal Behaviour is an integrative theory which takes a multidimensional view incorporating both internal and external elements in determining behaviour (Triandis

1977). This provided for in-depth analysis of the drivers behind the various water use practices identified in this study.

The theory recognises the key role played both by social factors and by emotions in forming intentions, it explains how behaviour patterns result from a combination of what is intended, habitual responses, and situational constraints and conditions under which a person operates (*i.e.* facilitating conditions or external elements (Triandis, 1977).

In the theory of interpersonal behaviour, intentions are immediate antecedents of behaviour and are influenced by social, normative and affective factors as well as rational deliberations. The theory also considers past behaviour, or habit, in facilitating present behaviour, while intentions have three antecedents which are; Attitudes or the perceived value of expected consequences, Social factors, including norms, roles and self-concept and affective factors, or emotional responses, (Triandis 1977). Norms are social 'rules' about what should and should not be done. Roles are sets of behaviour that are considered appropriate for a particular person in a particular situation and self-concept is the self-assessment of one's self and what activities one should pursue and engage in. The theory also states that in framing an intention, an individual's emotional response to a decision may depend on rational instrumental evaluations of consequences, and may include both positive and negative emotional responses of varying strengths (Triandis 1977). All these factors were used to analyse the drivers behind water use practices in the study areas.

According to Jackson (2005), the most outstanding criticism of the theory of interpersonal behaviour is that it is very complex. However the complexity of the theory enables the consideration of other factors like habits and facilitating conditions which give a better analysis towards understanding behaviour.

This theoretical framework was chosen for this study because it will help to better understand and explain the drivers behind the domestic water use practices being employed in the two study areas and it gives a broader framework for analysing behaviour. The theoretical framework brings out the various factors that determine or influence the behaviour of an individual which are not provided for in other behavioural change theories hence the justification for its application in this study.

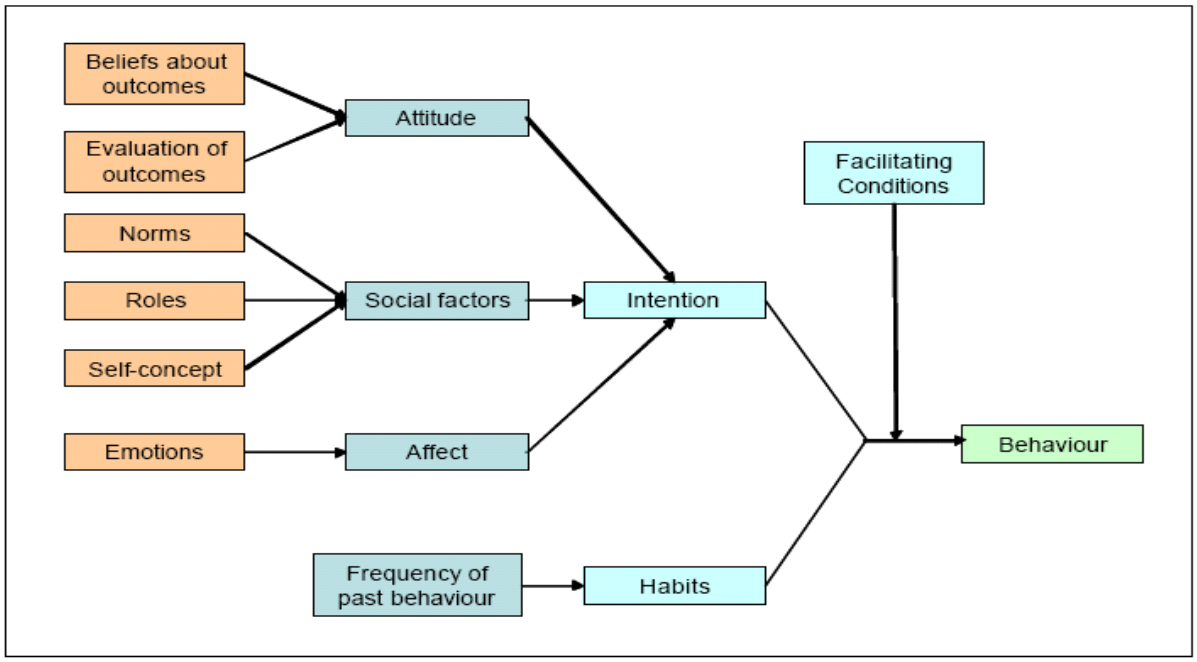

Figure 2.1: Triandis' Theory of Interpersonal Behaviour
Source: Triandis 1977, pp 26

2.10 Knowledge Gap

While much has been published on water management practises, there still exists very little empirical evidence particularly in Zambia on identification of water use practices, how the practices relate to water conservation and the drivers of domestic water use practices. In other words, scholarly work focusing on identification of water use practices, how the practices relate to water conservation and the drivers of domestic water use practices is scanty in Zambia. Therefore, this study attempted to narrow the said knowledge gap by focusing on investigating into the water use practices, how the practices relate to water conservation and the drivers of domestic water use practices specifically in Ndeke and Kansenshi residential areas of Ndola City.

CHAPTER THREE: DESCRIPTION OF THE STUDY AREA

3.1 Introduction

This chapter describes the location of the study area, the physical and social economic features of Ndola city and demographic characteristics.

3.2 Location and Size of the City of Ndola

Ndola lies between latitudes 12^0 and 16^0 South of the Equator and between 25^0 and 30^0 East. It is one of the 11 districts found on the Copperbelt Province of Zambia and shares its borders with three districts namely Masaiti, Luanshya and Kitwe. It also shares an international boundary with the Democratic Republic of Congo (DRC) to the north. The city is the Provincial Headquarters of the other Districts of the Copperbelt Province namely, Chililabombwe, Mufulira, Chingola, Kalulushi, Kitwe, Luanshya, Chambishi, Mpongwe, Lufwanyama and Masaiti. In terms of land cover, the City of Ndola is the third largest city in Zambia, covering some 110, 300 hectares with a 2019 population projection of about 574,437 (Greenline Environmental Solutions, 2013).

3.3 Physical Features of the City of Ndola

Ndola District lies on an altitude of 1269m above sea level. Generally, Ndola experiences a sub-tropical climate that is strongly seasonal, with three distinct seasons. Climatic conditions are characteristic of the second agro-ecological region of Zambia with a pronounced dry and rainy season. The rainy season start in November ending in April with a total annual rain fall ranging from 1000 to 1300 mm (Greenline Environmental Solutions, 2013). The dry season is divided into the cool dry season (May – July) with temperatures ranging between 8ºC and 21ºC and the hot dry season (August – October) with temperatures ranging between 21ºC- 32ºC . The rainy (hot wet) season is generally warm with temperatures ranging between 16ºC to 24ºC. Summary climatic conditions of the area are given in the tables below (Greenline Environmental Solutions, 2013).

The geology of Ndola area is characterized by numerous rock-types. It is mainly underlain by deep weathered sedimentary rocks of the Katanga Super group, which can be further subdivided into the Kundelungu Series, but also by the Mwashia Group and the Roan and Mine Groups. The characteristic features include the calcareous

mudstone and siltstone along the Zambia-Congo DR border from the southeast to the northwest in Misundu area (Moore,1968).

Surface water resources in Ndola are characterised by the presence of two main rivers, the Kansenshi River in the northern zone and the Kafubu River in the southern, along with their respective tributaries. Flow in these rivers is perennial due to the strong wet and dry season climatology of the equatorial regions; and many of the tributaries cease to flow during the dry season. Surface water resources include the main wetland in the north east of the city, locally known as a dambo, and the Itawa Spring a groundwater-fed spring located in Mapalo, covering approximately 2,000 m2 (Liddle, 2014). Ndola sits on three aquifers: the Bwana Mkubwa Aquifer in the southern zone, the Kakontwe Limestone Aquifer in the north-eastern zone, and the Skyways Industrial Area Aquifer, wedged between the first two. Surface water and groundwater resources are both used in state water provision in Ndola (Liddle, 2014). Water and Sanitation Services (WSS) in Zambia have been subject to neoliberal reform and commercialisation, whereby, Kafubu Water and Sewage Company (KWSC) holds the responsibility WSS in Ndola (Hall and Lobina, 2006).

The Ndola local topography slopes gently at an average altitude of 1,200m above sea level with isolated hilly outcrops such as Dola and Kaloko Hills. The general terrain is generally gently sloping with a bi-directional slope averaging between 1% - 1.5% towards the North-Eastern direction slopping in the direction of the Kafubu River (Greenline Environmental Solutions, 2013). Ndola is mostly composed of Miombo woodland. Miombo (Brachystegia) is a genus of trees comprising a large number of species. Miombo woodland is classified in the tropical and subtropical grasslands, savannas, and shrub lands. The Miombo woodland is usually distinguished by its three dominant species, the Brachystegias, Julbernadias and Isoberlinias. Other common tree species include Uapaca, Pterocarpus, Piliostigma, Pseudolachnostylis, Acacia and Combretum. In most cases, variations occur in small patches forming pure stands of Uapaca kirkiana, and also termitalia Miombo do exist side by side with dominant woodlands (Greenline Environmental Solutions, 2013).

3.4 Social Economic Features of the City of Ndola

Ndola is the first town to be established on the Copperbelt as an administrative center in 1904. Its establishment was preceded by the discovery of copper at the Bwana Mkumbwa five (5) kilometres from the Central Business District. The railway line

reached Ndola soon after this in 1910. The discovery of copper later at Nkana encouraged investors to extend the railway line to present day Kitwe. Being a colonial administrative center, Ndola developed quickly so that in 1932 it was declared a municipality. The colonial government offices could originally be found where the Ndola Golf Club stands today. The town grow very fast due to mining in the Bwana Mkubwa and other locations on the Copperbelt. Ndola was granted city status in 1967 (Siachoona, 2003).

Ndola is the second largest city of the Copperbelt and developed as the leading industrial centre of Zambia, covering many sectors including manufacturing, consumer services, mining, tourism, transport, chemical, textiles, construction, and agriculture and forestry (PADCO, 2001). However, success in the Copperbelt was short lived, whereby a steep economic decline marked the 1990s, with per capita income falling by more than 50%, resulting in Zambia ranking bottom of the World Bank's hierarchy of developing nations (Ferguson, 1999). Unfortunately this downturn coincided with the Structural Adjustment Programmes (SAP) of the 1990s, resulting in the closure of 75% of formal sector plants in Ndola, including its only active mine (Bwana Mkubwa), resulting in high levels of unemployment and under development (PADCO, 2001).

By the late 2000s, the privatization of state mines led to renewed foreign investment in copper mining (DiJohn, 2010), including the re-opening of the Bwana Mkubwa Mine under the ownership of First Quantum Minerals (Hampwaye 2008). Foreign investment in mining across the Copperbelt has yielded little revenue to the Zambian Government due to the taxation incentives that were offered to attract foreign investment in the first place largely cutting out any profit-return. For example, in 2006 the government received only $25 million in copper royalties from the $US2 billion turnover in copper sales (DiJohn, 2010). Despite considerable mineral wealth and export turnover, 64.2% of the local population live below the poverty line, while current life expectancy is forty-nine years, and the Human Development Index (HDI) rank is 164/187 (UNDP, 2012).

3.5 Study Sites

This study was conducted in Kansenshi and Ndeke residential areas of Ndola City. Kansenshi is about 2 to 3 kilometres North West of the Central Business District (CBD). The boundaries of the sample study area within Kansenshi are Ndibu Road in

the east, Petauke Road in the north, Kariba Road in the south and Mkuni Road in the west. Ndeke is about 4 to 5 kilometres from the Central Business District (CBD). The boundaries of the sample study area in Ndeke are Ndeke Road in the North, Magesi Road in the South, Kalungulungu Road in the East and Fyakale Road in the West (GRZ, 2015)

These areas were selected because they are fully serviced with water by Kafubu Water and Sewerage Company and they are both metered. They area were also easily accessible for data collection. Ndeke is a medium cost residential area characterised by medium cost housing infrastructure while Kansenshi is a high cost residential area characterised by high cost housing infrastructure. Therefore, it was interesting to learn how the water use practices vary in these two areas and to learn which community is more aware about water conservation and are actually practicing sustainable water use practices in their community. The total number of households in Kansenshi was 62 while Ndeke had 105 households, (GRZ, 2015). Both Ndeke and Kanseshi are not former mining townships hence before the introduction of the Commercial Utilities, provision of water to the areas was done by the Council. Kanseshi is a high cost colonial settlement whereas Ndeke is a post independence medium cost settlement.

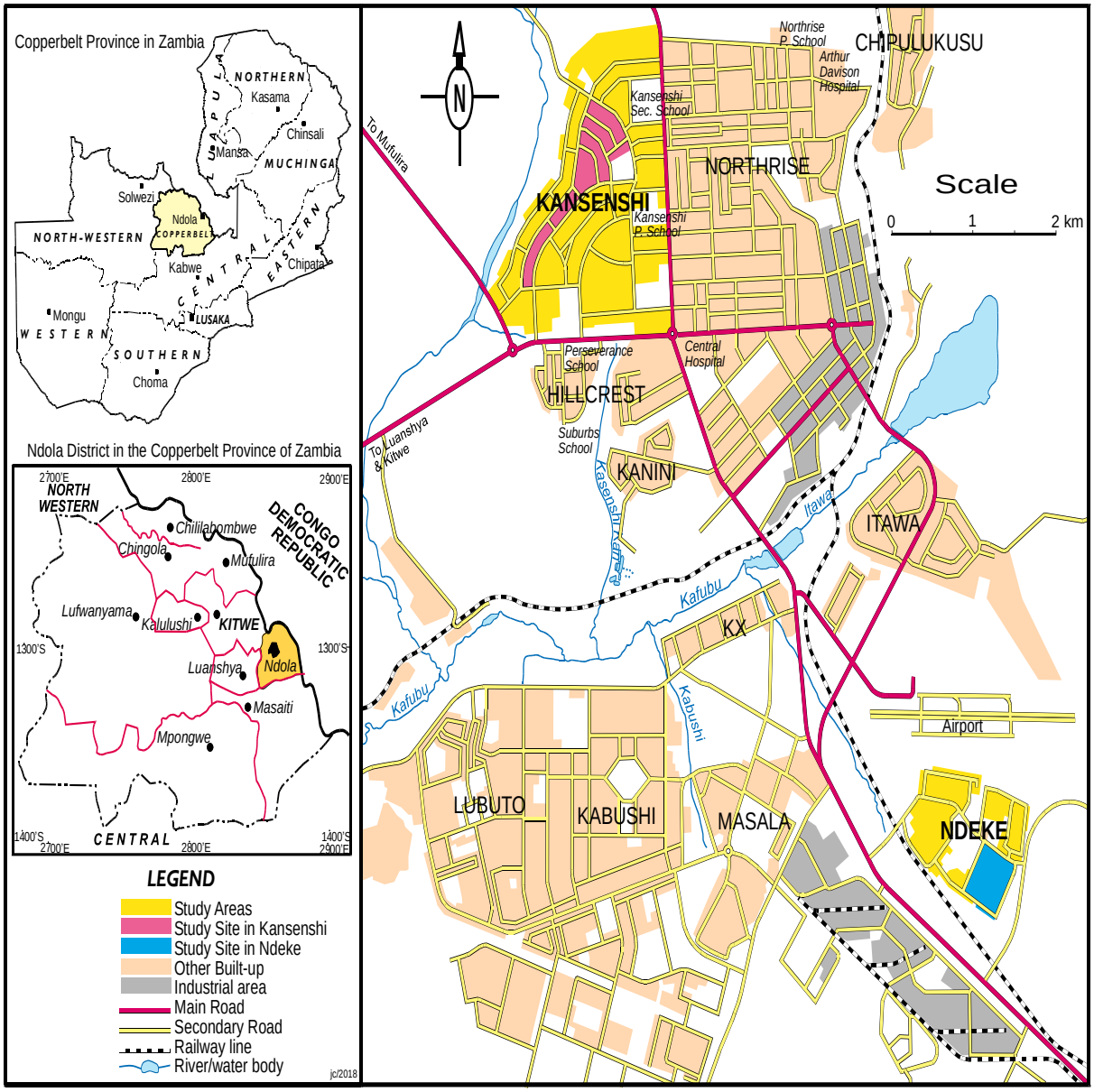

Figure 3.1: Map of Ndeke and Kansenshi

Source: Ndola City Council Shapefile,2013.

CHAPTER FOUR: RESEARCH METHODOLOGY

4.1 Introduction

This chapter describes the research design employed in the study, the sampling procedures, data collection tools and methods and also the data analysis techniques.

4.2 Research Design

The research design employed in this study was Cross Sectional non-experimental descriptive research design. Cross Sectional research involves comparing two or more pre-existing groups of people and it is non-experimental because there is no manipulation of an independent variable and no random assignment of participants to groups (Setia, 2016). This study involved comparing domestic water use practices of the two pre-existing areas of Ndeke and Kansenshi. This design was appropriate for this study because; the research questions and hypotheses related to a single variable rather than a statistical relationship between two variables.The research questions pertained to non-causal statistical relationship between variables and the aim of the study was broad and exploratory i.e. to examine the domestic water use practices of the households of Ndeke and Kansenshi (Onwuegbuzie and Collins, 2007).

Both qualitative and quantitative approaches were employed in this study, this is because approaching research using both qualitative and quantitative techniques allowed the researcher to maximise the benefits of using more than one data collection tool for in depth data exploration, a principle known as triangulation (Onwuegbuzie and Collins.,2007). In this study, interview schedules were used as a qualitative data collection tool to allow for in-depth discussions and detailed data collection. The questionnaires were used as quantitative data collection tools and they also included open ended questions which were analysed qualitatively.

Qualitative data was collected on the types of water use practices being employed in the study areas and in depth data was collected qualitatively on the drivers behind the types of water use practices being employed. This enabled in depth understanding of the study topic.

The research instruments that were used to collect data included questionnaires and semi structured interview schedules (Questionnaire= Appendix I, Interview Schedule: KWSC= Appendix II, Interview Schedule: NWASCO= III, Interview Schedule:

WARMA= Appendix IV). A questionnaire is a set of questions with a pre-determined set of choices or answer and is mainly used to collect quantitative data (Bird, 2009). Some of the advantages for using a questionnaire are that; firstly, data collection is fast and easy since the answers are pre-determined. Secondly, data analysis and visualisation is easy and faster and thirdly, data collected using questionnaires can be compared and contrasted with other research and may be used to measure change. The disadvantages for using questionnaires include the fact that respondent bias can lead to inaccuracies in the data collected (Bird, 2009). Semi structured interview schedules are a set of open-ended questions that allow for a discussion with the interviewee and additional questions to be asked when need arises, they are used to gather qualitative data. (Jamshed, 2014). Advantages of using semi-structured interview schedules are that large amounts of detailed data is generated and is reliable and comparable while the disadvantages are that the data collected is difficult to analyse and they can be time consuming (Jamshed, 2014).

Primary data sources were used in this study and the sources included respondents from the two study sites for which the study targeted the Women (Woman of the House). In cases were the Woman was not available the second next elderly woman of the household or the eldest adult present was interviewed. Another source of primary data were the key informant from selected key institutions which included; Kafubu Water and Sewerage Company, WARMA and NWASCO. The target group for the household questionnaires were the women because the researcher believed they would have more reliable information on the study topic. Two research assistants were trained to assist in the data collection exercise, the data was collected in June, 2018 for a period of four (4) weeks. Consent for entry into the two areas was sought through the office of the District Commissioner for Ndola City. The questionnaires were administered by the researcher and the two research assistants. Interpretation of the questions in the common local language in the area which is *ici bemba* was done when the respondent was not comfortable with using English. Informed consent was also obtained in the local languages or English.

4.3 Sampling

Purposive sampling was used to select the key informants. The key informants included officers from Kafubu Water and Sewerage Company (KWSC), Water

Resources Management Authority (WARMA) and National Water and Sanitation Council (NWASCO). The key informants were selected purposively because they were believed to have more knowledge on the study topic. Quota sampling was used to select the two study sites. Quota sampling is a non-probability sampling method of gathering representative data from a group. As opposed to random sampling, Quota sampling requires that representative individuals are choosen out of a specific sub-group, (Yang and Banamah, 2014). In Quota sampling the assembled sample must have the same proportion of individuals as the entire population with respect to known charecteristics (Yang and Banamah, 2014). In this case the proportion of households that were metered and connected to KWSC water supply in the sub groups of the two study sites was the same as that of the entire group (Ndeke and Kansenshi residential areas). Quota Sampling was done by dividing the population into subgroups. A subgroup was selected and sample size calculated reflecting the subgroup population proportion.Systematic random sampling was then used to select the households. The two study sites were selected because they provided a basis for comparison since one is a medium cost area while the other is a high cost area, also the two study areas are both serviced with water by Kafubu Water and Sewerage Company and they are both using the same metering system. The sampling frame for the two study sites were obtained from the location layout maps which were obtained from Ndola City Council. The sampling frame for Kansenshi area comprised 62 households while the sampling frame for Ndeke area consisted of 105 households. The sample sizes were 56 households for Kansenshi and 82 households for Ndeke. The formula below provided in Renckly *et al* (1996) was used to determine sample sizes;

Equation 1

$$n = \frac{N \times Z2 \times 0.25}{[d2 \times (N - 1)] + [Z2 \times 0.25]}$$

Where; n = sample size required

N = total population

d = precision level (p-value) usually 0.05 or .10

Z = number of standard deviation units of the sampling distribution corresponding to the confidence level.

Confidence Level= 95%

To select the households the N^{th} technique was used (Renckly *et al*, 1996) where the population of interest (Sampling frame) was divided by the sample size; that is:

Equation 2

$$F = N/n$$

Where **F** is the frequency, **N** is the Sampling frame and **n** is the sample size, for Ndeke N/n was 1.28 and for Kansenshi N/n was 1.2. Therefore for both Ndeke and Kansenshi the households were interviewed consecutively as listed on the location layout map.

4.4 Data Analysis

Both qualitative and quantitative methods were used to analyse the data. Single Variable Analysis, Two Independent Sample T-Test and Two Sample Z- Proportions Test was employed to analyse quantitative data. The data that was analysed by single variable analysis was in relation to the background data and demographic data of the respondents, assessment of how water use practices related to water conservation and the drivers behind the water use practices. The data that were analysed by the Two Sample Z- Proportions test was on the prevalence of water use practices in the two areas, level of access of water from Kafubu Water and Sewerage Company and community awareness on water conservation. Two- Independent Sample T-Test was used to show if there were statistically significant differences in mean income and mean expenditure on water per month in the two areas. The statistical analysis software, Statistical Package for Social Sciences (SPSS) 16.0 was also used to generate frequency distributions on the variables measured (SPSS Inc., 2007), the data was then transferred to Microsoft Excel Office Professional Plus 2016 (Microsoft Excel Inc., 2013) for generation of figures. The Two Sample Z-Proportions Test and Two Independent Sample T-Test was employed using Minitab 14 (Minitab Inc., 2003) at 5% level of significance.

The formulas below were used to calculate the means and standard deviations for grouped data on mean combined income and monthly payment for water;

Equation 3

$$\text{Mean} = \sum mf/n$$

where:

m=Midpoint

f=Frequency

n=sample size

Equation 4

$$\text{Standard Deviation} = \sqrt{[\sum m^2 f - (\sum mf)^2/N] / N}$$

where:

m= Midpoint

f=Frequency

N= Sample Size

The qualitative data analysis method that was employed was Content Analysis. The content analysis was done by first defining the unit or theme of analysis which could be words, phrases or sentences. Each theme represented an idea. Categories and coding schemes were then developed for analysis. The data was then analysed and presented by verbating.Triandis' Theory of Interpersonal Behaviour was used to analyse the drivers behind the water use practices that were identified in the study. This was done by assessing whether the drivers of domestic water use practices identified in this study can be categorised to fall within any of the factors that have been stated to determine or influence behaviour as indicated in Traindi's theory.

4.5 Ethical Considerations

This being both a quantitative and qualitative study, it demanded interacting in depth with the participants, thereby entering their personal domains of values, weaknesses or strengths and individual learning abilities or disabilities to collect data. Understandably, this raises several ethical issues that should be addressed. In this study ethnical issues were addressed by; 1) seeking permission from relevant government departments before collecting data from the respondents working for these institutions, 2) asking the participants to give consent to participate in the study voluntarily, 3) instructing the participants to answer questions on anonymity terms and 4) informing the respondents about the purpose of the research in which they were requested to participate.

4.6 Validity and Reliability

Validity refers to the degree of adequacy with which a test measures phenomenon (Yin, 2003) while reliability is referred to as the extent to which results are consistent over time and an accurate representation of the total population under study. If the results of a study can be reproduced under a similar methodology, then the research instrument is considered to be reliable (Yin, 2003). In this study validity of data was achieved through triangulation of data obtained through questionnaires with data from the key informant interviews. To ensure reliability the data collection tools were pre tested for accuracy. The study employed both probability and non-probability sampling techniques. Thus, the findings of this study can be generalised to the larger population. In this case Ndeke and Kansenshi.

4.7 Study Limitations

In cases where the respondents were not Zambian nationals, language became a barrier hence more explanation and interpretation needed to be done for the respondents to fully understand the questions. This minimised the effect of language barrier on the results.

CHAPTER FIVE: FINDINGS AND DISCUSSION

5.1 Introduction

This chapter presents the findings and discussion of the study in line with the objectives. The chapter is presented under the following headings; i) Demographic Information of the Respondents and Background Information on Water ii) Domestic Water Use Practices iii) Domestic Water Use Practices and Water Conservation iv) Drivers Behind the Domestic Water Use Practices v) Community Awareness on Water Conservation and vi) Water Challenges in the Study Sites.

5.2 Demographic Information of the Respondents and Background Information on Water.

This section presents and discusses the demographic information of the respondents and background information on water. The section included; the distribution of respondents by sex and age, household size, education attainment, years of residence, water storage, source and availability of water, average combined income and monthly payments for water. These variables were important in understanding the water situation in the two areas and the general characteristics of the respondents.

5.2.1 Distribution of Respondents by Gender

The majority of the respondents in both study sites were women (Figure 5.1). This could have impacted positively on the findings of the study since the women are the ones who are mostly find at home and taking care of the home. In cases where the woman was not available to take part in the study the next oldest aldult present was interviewed. Only 24.4 percent of the respondents from Ndeke and 31 percent of the respondents fron Kansenshi were men.

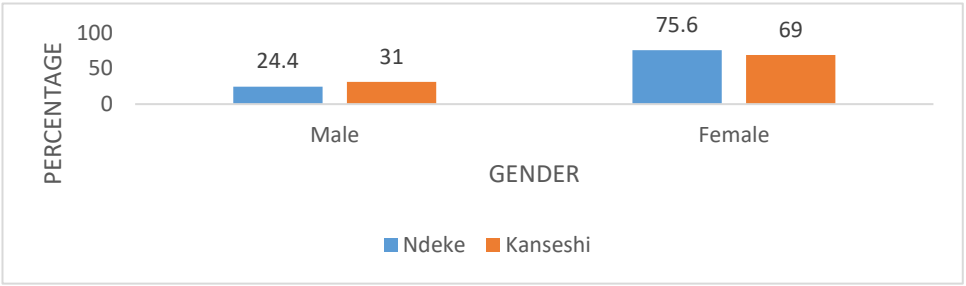

Figure 5.1: Distribution of Respondents by Gender
Source: Field Data, 2018

5.2.2: Distribution of Respondents by Age

In Kansenshi slightly over half of the respondent were of the age ranging between 31 to 40 years while for Ndeke area, the highest percentage was 31.7 with age ranging between 31-40 years as well .The least category of respondents in both areas was that of the age above 60 years. The number of households being headed by senior citizens was low as compared to those being headed by the youth and middle aged. This can be an indicator that if water conservation sensitisation programmes are employed successfully in the two study areas, the programmes could have a positive impact on the upcoming generations in terms of changing cultural beliefs and mind-set towards water conservation. Age has an influence on water consumption, (Manouseli et al., 2017) indicated that it is generally accepted that the elderly tend to consume less water in their homes than younger people possibly due to young people's more water intensive habits. Hence it is important to understand the age groups in an area in order to design appropriate water conservation mechanisms.

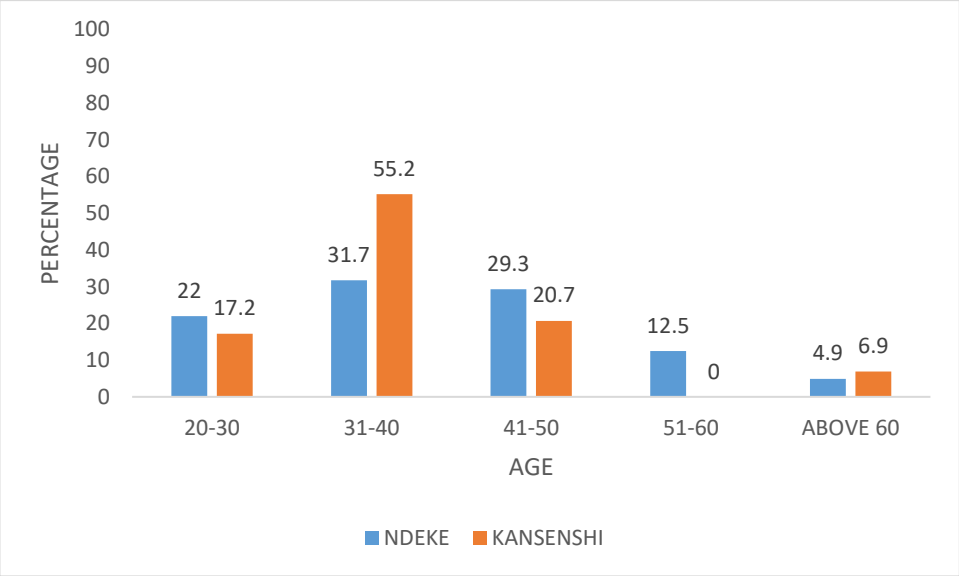

Figure 5. 2: Distribution of Respondents by Age

Source: Field Data, 2018

5.2.3: Household Size in Ndeke and Kansenshi Study Sites

The majority of the respondents in both Ndeke (51.2 percent) and Kansenshi (62.1 percent) had household sizes ranging from 5 to 8 while average household size for Ndola District as reported by the Zambia 2010 Census of Population and Housing report is 5.3 (CSO,2013). In relation to water conservation, according to Manouseli *et al.,* (2017) household size is a key driver of water demand and due to economies of

scale, average per capita consumption decreases as household size increases. This can be attributed to shared water-uses (e.g. cooking and garden watering) and there may be a household size threshold beyond which these economies of scale diminish, thus causing water consumption to be less than proportional to household size. This therefore shows that increase in household size does not necessarily mean a proportionate increase in water demand. This was also supported by Beal *et al.*, (2012) who indicated that; larger families were typically more water efficient on a per capita basis than small families.

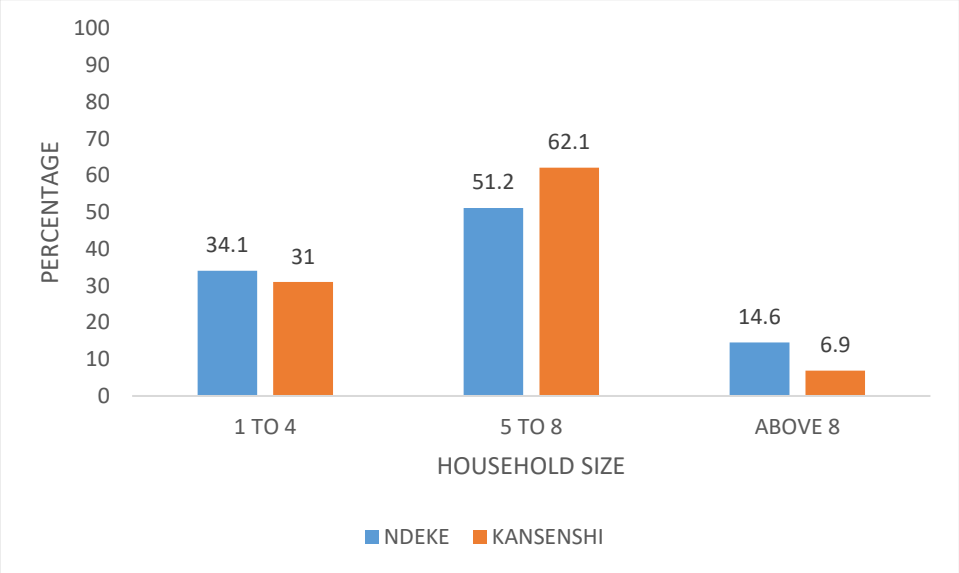

Figure 5.3: Household Size in Ndeke and Kansenshi Study Sites

Source: Field Data,2018

5.2.4: Education Attainment of the Respondents from Ndeke and Kansenshi

The results of the study on education attainment revealed that there were more respondents in Kanseshi (82.8 percent) who had reached tertiary level of education than in Ndeke (31.7 percent), probably because as a low density and high income residential area, Kansenshi is inhabited by residents with higher levels of formal education than Ndeke residents. Beal *et al.*, (2012) indicated that more educated households tend to install efficiency appliances which may not always be sufficient in reducing water consumption if curtailment actions are not present and hence he suggested that both water consumption behaviours, as well as technology need to be considered as part of a successful demand management strategy. Use of water efficient

appliances must be coupled with good water management practices for water conservation to be attained successfully. Also according to Dupont and Renzetti (2013) household characteristics such as education level are a significant factor affecting household water use practices and conservation.

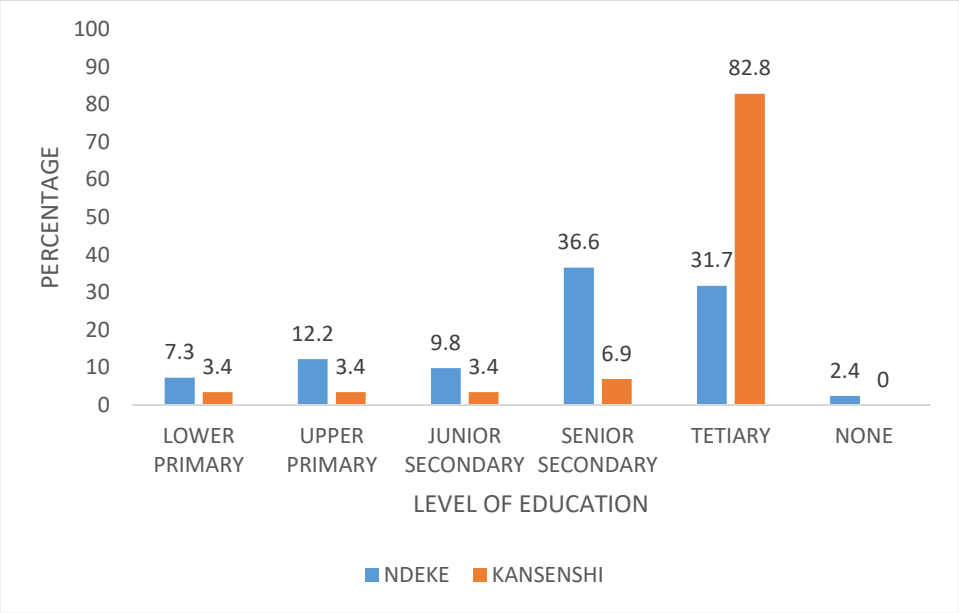

Figure 5.4: Education Attainment in the Study Sites

Source: Field Data, 2018

5.2.5: Years of Residence of the Respondents in the Study Sites

About half of the respondents in both study sites had lived in the respective areas for a period of 1 to 5 years (Figure 5.5). It was important to have an overview of how long the respondents had lived in the areas because validity of the information given on water availability and sensitisations on water conservation in the areas was dependant on how long the respondents had lived in the two areas. The longer an individual lives in a community, the more experience they could have on the issues affecting that community hence their views and opinions about that particular area would be better informed.

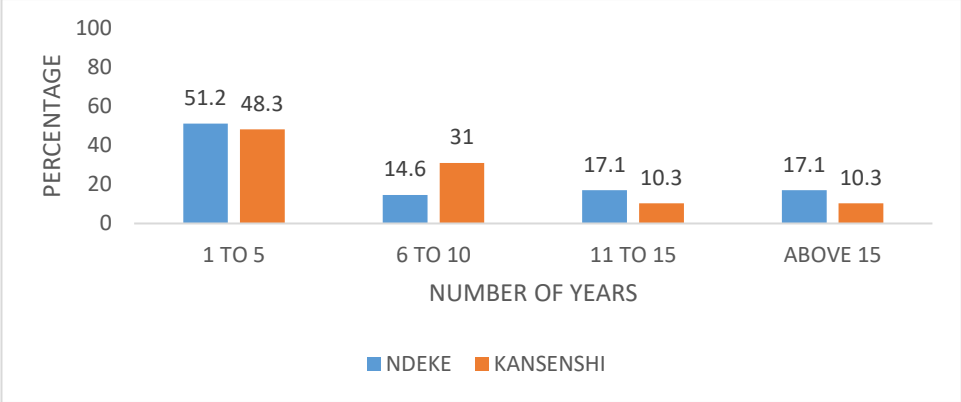

Figure 5.5: Years of Residence of Respondents in the Study Sites

Source: Field Data, 2018

5.2.6: Monthly Household Incomes of Kansenshi and Ndeke Residents

There was a statistically significant difference in the mean monthly incomes for the two study sites (Table 5.1). Monthly household income was higher in Kansenshi with (48.3 percent) of the households earning between ZMW 6 000 – ZMW 10 000 per month while (34.5 percent) earned between ZMW 11 000 and ZMW 15 000 per month. In Ndeke 70.7 percent of households earned between ZMW 1 000 and ZMW 5000. This seems to provide support for the categorisation of the two areas as high-income and middle-income residential areas adopted during the current study. Manouseli *et al.,* (2017) indicated that household income affects domestic water demand and in general consumption of water is found to increase with affluence. Mohandas (2013) also indicated that in india households with high income are said to consume more water than low income huseholds.

Table 5.1: Monthly Average Household Incomes of Kansenshi and Ndeke Residents

Sample	N	Mean (ZMK)	StDev	T-Value	P-Value
Ndeke	82	4646	3027	-10.31	0.0001
Kansenshi	56	10500	3525		

Source: Field: Data, 2018

5.2.7: Water Source in Ndeke and Kansenshi Study Sites

A large majority of households (95 percent in Kansenshi and 82 percent in Ndeke) had access to piped water. There was no statistically significant (p=0.989) difference in

the proportion of respondents accessing water from Kafubu water and sewerage company in the two areas (Table 5.2). This finding could be because both areas are serviced with piped water from KWSC, hence in a short term it is much cheaper for the community to access safe water from KWSC unlike other safe alternatives like underground water through borehole, which are much more expensive to drill.

These results are in agreement with Coetzee *et al*., (2016) whose results revealed that (76.5 percent) of the respondents in their study area in the North West Province of South Africa mostly obtained their water from local government sources. In Zambia the Local Government has delegated the responsibility of water supply and sanitation to Commercial Utilities.

Table 5.2: Access of Water from KWSC in the Two Study Areas

PARAMETER	**NDEKE**	**KANSENSHI**
N (Sample Size)	82	56
Events	78	46
Sample Proportion	0.951	0.821
Z-Value	2.30	
P-Value	0.989	

Source: Field Data, 2018

Interviews with a key informant from the Water Resources Management Authority (WARMA) revealed that out of all the boreholes the Authority had registered and out of all the borehole drilling applications the Authority had received, only about one (1) percent of them came from Ndeke and Kanseshi area. This indicates that indeed the major water source for the households in the two study sites was the piped water supply from KWSC.

The key informant from KWSC revealed that un-protected shallow wells were being used by some residents from Ndeke because the water table in the area is high. The company had not observed the use of shallow wells in Kansenshi. It was mentioned that the use of shallow wells in Ndeke was discouraged by KWSC because the water from these wells was polluted and had a bad odour which was a danger to the health of the residents. The key informant from KWSC also mentioned that some residents were not very cooperative in burying these wells because they used the water from the

wells for other non-consumption uses like watering the lawns and gardens. These results indicated that the majority of the respondents in both areas had access to safe water that was provided by KWSC whose standards for quality service provision are regulated by NWASCO.

5.2.8: Water Availability in Ndeke and Kansenshi

A total of 56.1 percent (Ndeke) and 58.6 (Kansenshi) percent of the respondents indicated that they did not have water available 24 hours in a day. The key informant from KWSC revealed that during the hot and dry season, water availability in the two areas was erratic because water levels at the Kafubu dam become low. Thereby reducing the amount of water available for supply to the communities. KWSC responded to this seasonal reduction in water by rationing the water it supplies to the households. This prompted households to store water using several methods (Figure 5. 6).

5.2.9: Method of Water Storage in Ndeke and Kansenshi

In Ndeke the most popular method of water storage was the use of buckets while in Kansenshi it was the use of drums (210 litres drums). The results showed that most people in both areas practice simple indoor water storage methods as opposed to mechanised water storage systems such as elevated outdoor reserve tanks. The use of outdoor elevated water tanks connected to the household reticulation system could be encouraged because they are more hygienic than handling water stored in buckets and drums.

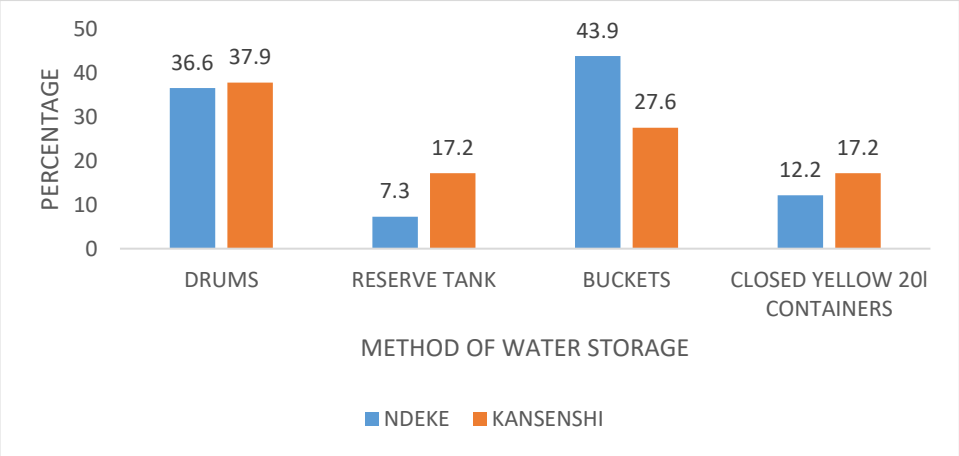

Figure 5.6: Water Storage Methods during Rationing
Source: Field Data, 2018

5.2.10: Monthly Payment for Water

There was a statistically significant difference in monthly payment for water in Ndeke and Kansenshi (P- Value= 0.0001). In Kansenshi area water bills were higher compared to Ndeke area (Table 5.3). According to Manouseli *et al* ., (2017) overall, below a certain volume of water consumption, water demand is often found to be unresponsive to price change, making water price manipulation an ineffective tool for demand control. Other scholars have also argued that; the essential logic is that higher water prices lead to lower consumption (Shaw, 2005), when water is treated as a pure economic good. However, Savenije (2002) notes that water is far from behaving as a normal economic good because for most uses water is irreplaceable.

For Kansenshi and Ndeke high water price did lead to lower consumption just as indicated in (Shaw, 2005). Some residents in both areas indicated that they used basin to rinse their clothes because using basins consumed less water which in turn reduced on water bills. In some cases high water bills caused residents in the two study sites to discontinue certain activities, for instance one of the women respondents mentioned that;

"Nowadays we do not even water the lawns because the water bills that we receive from KWSC are too high"

Table 5.3: Monthly Payment for Water

Sample	N	Mean	StDev	T-Value	P-Value
Ndeke-Sample 1	82	202	103	-4.57	0.0001
Kansenshi-Sample 2	56	336	201		

Source: Field Data, 2018

5.3: Prevalence of Domestic Water Use Practices in Ndeke and Kansenshi

This section presents results on the prevalence of the five domestic water use practices among the residents of Ndeke and Kansenshi.

5.3.1 Prevalence of Bathing Methods

Bathing is one of the main indoor household water end uses, according to Shan *et al*., (2015) showering accounts for a quarter of the water consumed within UK households. In the Netherlands, a population survey indicated that the main end uses of household water were shower (40 per cent), toilet (28 per cent) and washing machine (12 per cent). In this study three (3) methods of bathing were looked at, these included; the use of a shower, use of a bath tub and the use of a bucket. The majority of the respondents in both areas used the bucket. (Table 5.4). For shower use, there was no statistically significant difference in the proportion of respondents using showers in Ndeke and Kansenshi (Z= -1.13, p=0.129). This could be because both areas are connected to piped water from KWSC. This could mean that availability of water in both areas was the same. Hence in both areas the level with which alternative methods like the use of buckets are practiced when water is not available are the same. Ndeke had less respondents using the bath tub for bathing compared to Kansenshi (Z= -2.64, p=0.004). Since Ndeke is a medium cost area while Kansenshi is a high cost area, Ndeke could have a low proportion of respondents using a bath tub to bath because in a high cost area, more households are expected to have bath tubs fitted in their homes compared to medium cost areas. The proportion of respondents using the bucket for bathing was higher in Ndeke compared to Kansenshi (Z=2.47, p=0.007). This showed that opportunities for conserving water in Ndeke were higher than in Kansenshi because the use of bucket promotes water conservation. The residents of Ndeke could be using less water for bathing because a more conservative method of using buckets was more prevalent in the area compared to Kannsenshi.

Table 5.4: Prevalence of Bathing Methods

Water Use Practice	**Ndeke (n=82)**	**Kansenshi (n=56)**	**Z-Value (p-Value)**
	Percentage of Respondents (%)	**Percentage of Respondents (%)**	
Personal Hygiene			
Body Wash			
Use of shower	31.7	41.4	Z=-1.13 (p= 0.129)
Use of bath tub	2.4	13.8	Z= - 2.64 (p = 0.004)
Use of bucket	65.9	44.8	Z = 2.47 (p = 0.007)

Source: Field Data, 2018

5.3.2 Prevalence of Teeth Brushing Methods

Ndeke had a higher proportion of respondents using the cup to brush their teeth compared to Kansenshi (Z=5.77, p=0.0001). For tap use, Ndeke had a lower proportion of respondents using the tap to brush their teeth compared to Kansenshi (Z=5.77, p=0.0001)**.** The use of cups was most common in Ndeke a medium cost area while use of taps was common in Kansenshi. This could be because the use of cups in Ndeke had become more of a tradition because the residents of Ndeke did not usually have running water from the tap hence they used cups to draw water from buckets. Another reason could be that it is out- dated for the people of Kansenshi to use a cup instead of a tap which is a more modern method and the residents of Kansenshi could be experiencing less incidences of water shortages there by making the use of taps more convenient for them.

5.3.3 Prevalence of Laundry Methods

There were no statistically significant differences in basin use, use of a washing machine, use of a laundry sink and use of a bath tub for laundry in the two areas (Table 5.5).

Table 5.5: Prevalence of Laundry Methods in Ndeke and Kansenshi

Water Use Practice	**Ndeke (n=82)**	**Kansenshi (n=56)**	**Test Statistics**
	Percentage of Respondents (%)	**Percentage of Respondents (%)**	
Laundry			
Use of Basin	87.8	93.1	Z= - 0.97 (p= 0.833)
Use of Washing machine	2.4	3.4	Z= - 0.39 (p= 0.349)
Use of Bath Tub	4.9	0	Z= 1.68 (p= 0.953)
Use of Laundry Sink	4.9	3.4	Z= 0.37 (P= 0.644)

Source: Field Data,2018

Lack of differences in the laundry method could be because in both areas the residents preferred to wash from outside because that was where the drying of the clothes was done from. This could have made the use of laundry sinks which were usually placed

outside to be more convenient for the residents. However, it was not so as only 4.9 percent (Ndeke) and 3,4 percent (Kansenshi) of the respondents used the laundry sinks. The use of washing machines could be un-popular because washing machines are expensive to purchase, making them un-available in the homes.

Figure 5.7: Community Member in Kansenshi Doing her Laundry
Source: Field Data, 2018

5.3.4 Prevalence of Garden Watering Methods

Gardening strongly affected water consumption because watering gardens accounted for the largest outdoor water use, or specifically, more than 50% of outdoor water consumption(Fan *et al*., 2013). Three (3) garden watering methods were looked at in this study, the use of a bucket, use of a sprinkler and use of a hosepipe. The results indicated that there was no statistically significant difference in the proportion of respondents using a bucket for garden watering in Ndeke and Kansenshi (Table 5.6). Ndeke had a lower proportion of respondents using the sprinkler for garden watering compared to Kansenshi (Z-1.72, p=0.042). Ndeke also had a lower proportion of respondents using the hosepipe for garden watering compared to Kansenshi (Z= -2.01, p= 0.022). More respondents were using hosepipes and sprinklers in Kansenshi, a high cost area, compared to Ndeke, a medium cost area. This could be because hosepipes and sprinklers are more expensive to purchase than buckets hence the people of Kansenshi are more likely to afford them compared to the residents of Ndeke.

Table 5.6: Prevalence of Garden Watering Methods

Water Use Practice	Ndeke (n=82)	Kansenshi (n=56)	Test Statistics
	Percentage of Respondents (%)	Percentage of Respondents (%)	
Garden Watering			
Use of Bucket	36.6	31	Z= 0.76 (p= 0.224)
Use of Sprinkler	0	3.4	Z= -1.72 (p= 0.042)
Use of Hosepipe	26.8	44.8	Z= -2.01 (p= 0.022)

Source: Field Data, 2018

5.3.5 Prevlence of Dish Washing Methods

Two (2) methods were examined under dish washing, these were use of a kitchen tap and use of a basin. Ndeke had a higher proportion of respondents using the basin for dish washing compared to Kansenshi but a lower proportion using the kitchen tap to wash their dishes compared to Kansenshi (Table 5.7). This could be because Ndeke experienced more frequent water shortages (NWASCO, 2017) hence the residents are forced to wash the dishes using basins. The use of basins could also be a cost saving measure for the people of Ndeke. According to Shan *et al*., (2015) three major motivations to use water efficiently at home are to save water, to help the environment, and to save money.

Table 5.7: Prevalence of Dish Washing Methods

Water Use Practice	Ndeke (n=82)	Kansenshi (n=56)	Z-Value (p-Value)
	Percentage of Respondents (%)	Percentage of Respondents (%)	
Dish Washing			
Use of Basin	36.6	13.8	Z= 2.88 (p= 0.002)
Use of Kitchen Tap	63.4	86.2	Z= - 2.88 (p=0.002)

Source: Field Data, 2018

Below is a figure showing a woman washing dishes using the tap method in Ndeke.

Figure 5.8: Community Member from Ndeke Washing Dishes by use of a Kitchen tap

Source: Field Data, 2018

5.3.6 Prevalence of Car Washing Methods

In Ndeke 48.8 percent of respondents did not own cars while in Kansenshi only 20.7 percent of the respondent did own cars, this could be because of the fact that Ndeke is a medium cost area while Kansenshi is a high cost area. Out of the respondents who owned cars only 19.5 percent and 37.9 percent washed ther cars from home (Figure 5.9).

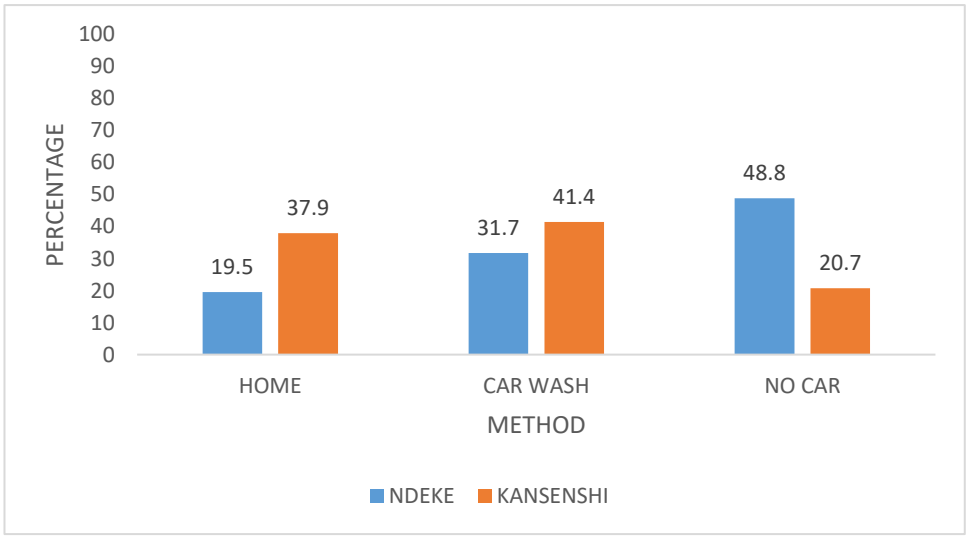

Figure 5.9: General Car Washing Method

Source: Field Data. 2018

Two (2) methods were examined under home car washing, use of a bucket and use of a hosepipe. There was no statistically significant difference in the proportion of respondents using the bucket to wash their cars in Ndeke and Kansenshi (Z=-1.77, p=0.961), as well as the respondents using the hosepipe for the two areas (Z= -1.30, p= 0.097).

5.4 Domestic Water Use Practices and Their Relation to Water Conservation

5.4.1 Water Conservation When Bathing Using the Shower

Out of the 34.1 percent of the people who said that they use a shower in Ndeke, 71.4 percent said they close the tap when they are scrubbing the body and 28.7 percent didn't. In Kansenshi, out of the 41.4 percent of the respondents that used a shower, 58.7 percent said they close the tap when they are scrubbing the body while 41.87 percent did not. The results indicated that the majority of the respondents in both areas were conscious about saving water while they took their bath. This could be because the residents were mindful about conserving water and that they wanted to reduce on the water bills.

In Ndeke out of 34.1 percent of the respondents that used the shower, 78.5 percent reportedly advised the members of their households to close the taps when not in use. In Kansenshi out of 41.4 percent of the respondents that used showers, 75.5 percent reportedly advise the members of their households to close the taps when not in use. These results indicate that the respondents that used showers in both Ndeke and Kansenshi advocated for water conservation around their homes by advising the members of their households to close the taps when not in use. These results indicated a positive response towards water conservation in both areas. This could be because respondents in both areas perceived their water bills to be very exorbitant. This arguably made them to be conscious about how they used water in their homes.

5.4.2 Water Conservation When Using the Tap for Brushing of Teeth

Out of 26.9 percent of the respondents in Ndeke that brushed their teeth from a tap, 82 percent of them indicated that they close the tap when brushing the teeth and only open the tap for rinsing. Only 18.3 percent did not close the tap while brushing their teeth. In Kansenshi out of 72.4 percent that used water from the tap to brush their teeth, 58 percent of them respondents closed the tap while brushing whereas 42 percent did not.

The results show a positive practice towards water conservation in the homes. Most people closed the taps when brushing the teeth and only opened the tap to rinse the mouth and the tooth brushes. This could be because the residents wanted to conserve water as a means of reducing on the water bills. These findings were similar to Marandu et al., (2010) who indicated that behaviours associated with water conservation are; turning off water when brushing teeth, turning off the tap while washing vegetables and turning of the shower while soaping in.

In terms of advising members of the households to close the taps when not in use, out of 26.9 percent of the respondents from Ndeke that used water from the tap to brush their teeth, 82 percent of them advised the household members to close the tap while they brush the teeth. In Kansenshi out of 72.4 percent that used the tap, 77.28 percent of them advised the members of their household to close the taps when not in use. The results indicated that the majority of the respondents in both areas sensitised the members of their households to close that taps when not in use. This could be because the residents were mindful about saving water due to the high water bills that they received. It was evident during the research that most respondents from both Ndeke and Kansenshi were of the view that water bills were too high.

5.4.3 Water Conservation during Rinsing of Clothes

In relation to water conservation, 73.2 percent of the respondents from Kansenshi indicated that they close the taps when not in use, and 62.1 percent of the respondents from Ndeke did the same. The results revealed a positive practice towards water conservation in the homes. This meant that water was being conserved during the laundry exercise. Households only had to use enough water required for rinsing in the basins unlike rinsing directly from the tap which could take a longer time hence consuming more water.

The research also revealed a positive practice towards household sensitisation on water conservation. A large majority (85.4 percent) of the respondents from Ndeke advised the members of their household to close the taps while they rinsed their clothes while in Kansenshi 82.8 percent of the respondents advised their household members to do the same. The results indicated a positive attitude towards water conservation in the two areas.

In terms of water recycling or re-use, the results indicated that 41.5 percent of the respondents in Ndeke and 31 percent in Kansenshi recycled laundry water and re-used

it for watering the surroundings to suppress dust, watering the lawns, flowers and gardens and for flashing the toilet. Slightly over half (58.5 percent) of the respondents from Ndeke and 69 percent in Kansenshi did not re-use the laundry water.

5.4.4 Water Conservation during Dish Washing

Results indicated that in Ndeke out of the 85.4 percent of the respondents that used running water from the kitchen tap only 41.5 percent advised the members of their households to close the tap while they scrub the dishes. In Kansenshi out of the 86.2 percent that used the running tap, 51.7 percent did the same. This could be because the residents wanted to reduce on water bills which they perceived to be high.

5.4.5. Water Conservation during Hosepipe Use for Car Washing

The results indicate that out of 4.9 percent of the respondents that used a hosepipe to wash their cars in Ndeke, all of them closed the tap while scrubbing the car. Similarly all the respondents that used the hosepipe in Kansenshi closed the tap while scrubbing the car. The results revealed a positive attitude towards water conservation.

In relation to promoting household water conservation while washing cars**,** all the respondents that used a hosepipe in Ndeke advised the members of their household to close the tap while scrubbing the car while in Kansenshi 66.66 percent of the respondents that used the hosepipe to wash the car did the same (Figure 5.10). The use of a hosepipe to wash the car logically consumes more water compared to using water in a bucket. Bryx and Bromberg (2009) indicated that a water-use restriction also called a watering ban or hosepipe ban on outdoor use of water such as car washing was implemented in the state of Victoria in Australia as a means of conserving water at household level. In this study hosepipe use during car washing was evidenced hence it's could be discouraged in order to promote water conservation.

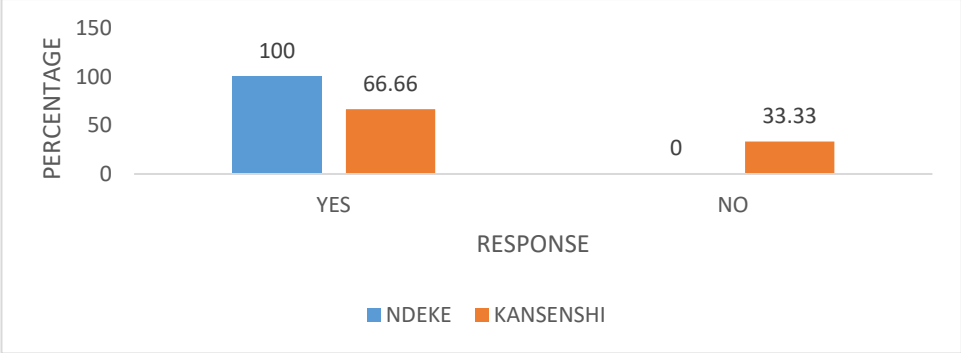

Figure 5.10: Advise to close the tap while scrubbing the car

Source: Field Data, 2018

5.5 Drivers of Domestic Water Use Practices

5.5.1 Drivers of the Bathing Methods

Respondents presented several drivers of the identified bathing methods (Figure 5.11).

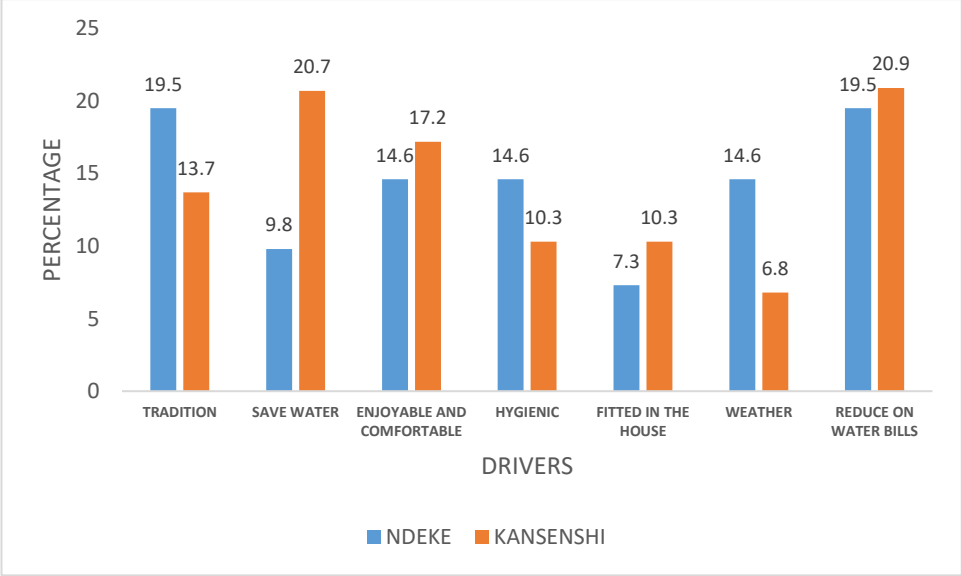

Figure 5.11: Drivers of the Bathing Methods

Source: Field Data, 2018

In both areas several drivers were given for the type of method used when taking a bath. Other drivers included household fixtures and weather. For instance, one of the women respondents from Kansenshi narrated that:

"I take a shower because it is the one that I found in the bath room when I moved into this house, more so I like taking a cold shower when it is hot during the hot season, in the cold season I use a bucket because it is the one I use to warm the water"

In relation to saving measures most people preferred to use buckets to take a bath so as to conserve water and reduce on the water bills. This indicated that water pricing can be employed as a measure for effective demand management and as a conservation measure as asserted by (Bryx and Bromberg, 2009). Those that gave hygiene reasons mentioned that to them the use of a shower was more hygienic than the use of a bath tub. In this study it was evident that household fixtures which are facilitating conditions do determine the method of water use practice. Respondents mentioned that for example they had to use a shower and not a bath tub because the shower is what was fitted in the house when they moved in. This also indicated that shifting construction designs of houses to green and eco-friendly type of construction and designs can achieve water conservation at household level. These findings are in agreement with (Bryx and Bromberg 2009) who noted that water efficient buildings are said to be a measure for effective water demand management.

Other drivers given for bath methods used included enjoyment, comfort and health benefits. These findings are in line with Trandis' Theory of Interpersonal Behaviour which is an integrative theory that takes a multidimensional view incorporating both internal and external elements in determining behaviour (Triandis 1977). The findings are also in line with the conclusion of (Pullinger *et al.*, 2013) that every day use of water is constituted, enacted and maintained by complex sociological reality including what services it provides such as cleanliness, comfort and convenience.

5.5.2 Drivers of the Teeth Brushing Methods

In both areas, drivers of the teeth brushing methods included saving measures in terms of water and bills, easiness, fastness and tradition. For example, a woman respondent from Ndeke mentioned that:

"I use a cup to brush my teeth because that is how I grew up, so that is what is normal to me"

In Kansenshi the residents felt that using a tap was much easier and faster than using a cup. Hence, evaluations and beliefs about the outcomes were seen to be key determinates of behaviour as indicated in Trandi's Theory of Interpersonal Behaviour.

5.5.3 Drivers of the Laundry Methods

Drivers given by the respondents for their choices of laundry method are as given in Figure 5.12.

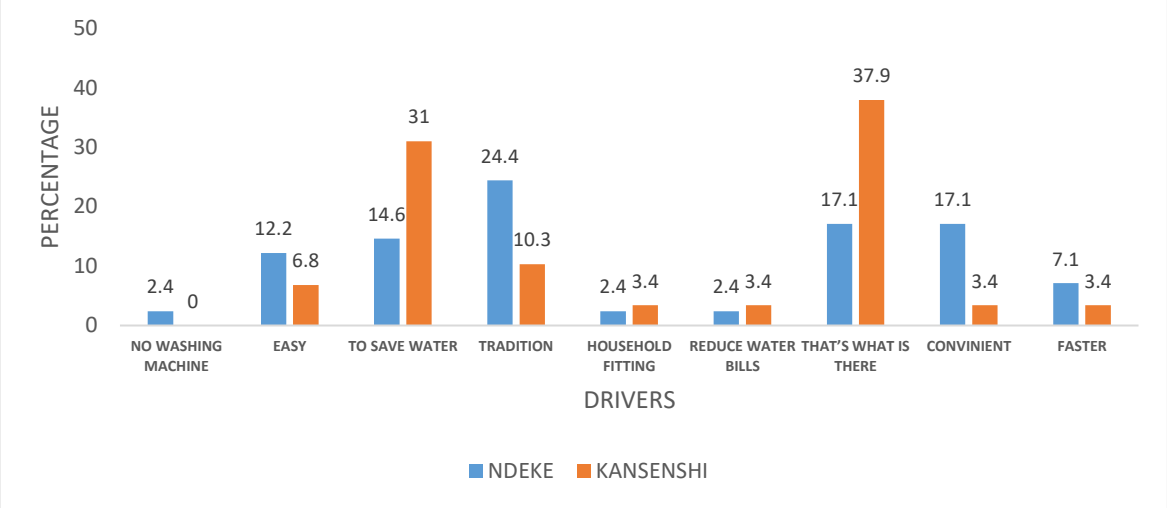

Figure 5.12: Drivers of the Laundry Methods

Source: Field Data, 2018

One of the women respondents from Kansenshi explained her choice of laundry method as follows;

"I use a basin to do my laundry because it is convenient because I can wash from outside if I don't want to do the laundry from the house"

Another woman respondent from Ndeke narrated that;

"I use a basin to do my laundry because it allows me to wash from outside, I can't do my laundry from inside because the smell of detergent chokes me"

The drivers behind the laundry practices were in line with Triandis theory of Interpersonal Behaviour. In this study habitual responses were seen to influence water

use practise in form of tradition. Respondents indicated that they were carrying out a practice in a particular manner because that was what they grew up doing and are hence used to. Facilitating conditions were also seen to determine how an individual conducted a particular practice. Facilitating conditions include household fixtures and high water bills. Other determinants of water use practices were perceptions on how convenient a method was. These findings were also in-line with the conclusion of (Pullinger *et al.,* 2013) that everyday use of water is enacted and maintained by complex sociological reality including what services it provides such as convenience.

5.5.4 Drivers of the Garden Watering Methods

Various drivers of the garden watering methods were indicated for both Ndeke and Kansenshi (Figure 5.13). One man from Kansenshi narrated the following;

" I use a bucket to water the garden because the water pressure is usually very low, so I have to wait for a bucket to get full for me to pour the water in the garden, then I can be doing other activities before the bucket gets full"

The dominant factors that influenced the garden watering methods were facilitating conditions, beliefs about outcomes and the evaluation of outcomes i.e. the low water pressure is a facilitating condition. Easiness, fastness, water saving measures, reducing on water bills and convenience are valuations and beliefs about outcomes. Respondents employed a particular practice because the equipment required for that practice was available. The situation of having low water pressure also influenced the practice of using a bucket and not hosepipes or sprinklers. Through the evaluation of outcomes, the respondents believed that use of a bucket could save water thereby reducing the water bill. These findings are in-line with Trandis' Theory of Interpersonal Behaviour that both internal and external elements determine behaviour (Triandis 1977). According to Jorgensen et al., (2009) garden type and lot size are main drivers of outdoor water use hence care must be taken to ensure that conservation strategies are employed during garden watering. According to a publication by the Government of Queensland (2019) drip irrigation is the most efficient irrigation method suitable for urban gardens because it emits consistent amount of water right below the surface and directly on the roots. Other water saving measures may include

installation of tap timer and electronic water controllers. However, these methods were not evidenced in this study.

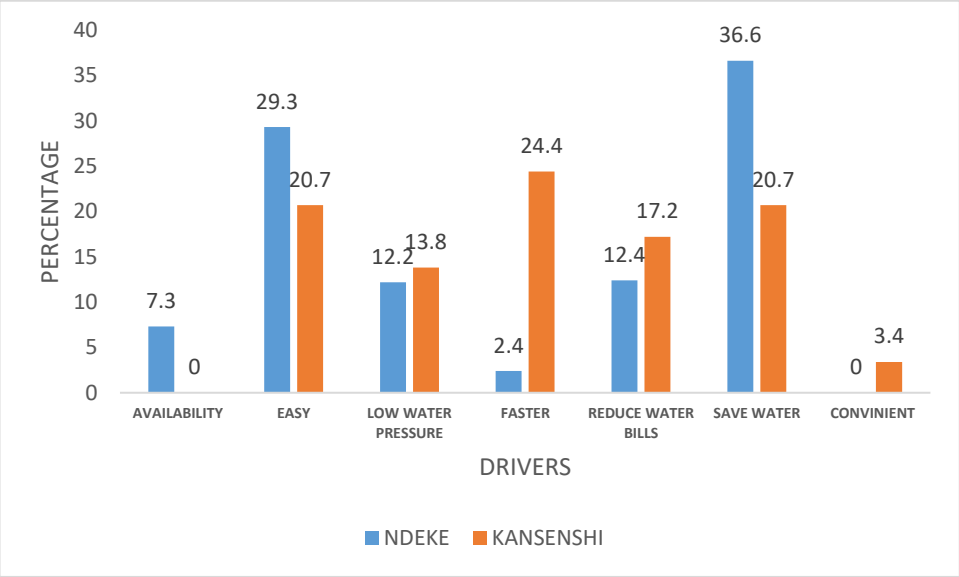

Figure 5.13: Drivers of the Garden Watering Methods

Source: Field Data, 2018

5.5.5 Drivers of Dish Washing Methods

In both areas various drivers of the method employed during dish washing were given (Figure 5.14). One woman respondent from Ndeke stated that:

"I use running water from the kitchen sink to wash the dishes because it is easy and faster, I don't have to start fetching water in the basins, I find it cumbersome because one has to use two basins one for a first rinse and the other for a second rinse, then one has to change the water if the dishes are many, so for me I prefer to use running water from the kitchen tap"

A total of 34.1 percent of the respondents in Ndeke and 41.1 percent of the respondents in Kansenshi mentioned that the method employed in washing the dishes was because they found it to be easy. Household fixtures were seen to be one of the major drivers behind the water use practices in Kansenshi and convenience was also a dominant driver. These results were in line with Traindi's Theory of Interpersonal Behaviour which incorporates facilitating conditions as a determinate of behaviour. Valuation

and beliefs about outcomes such as reduction on water bills and water conservation also played a role in determining behaviour.

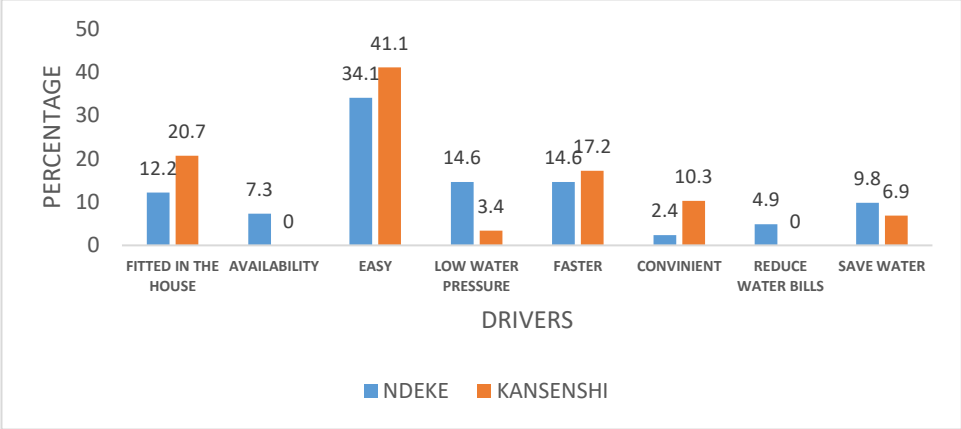

Figure 5.14: Drivers the Dish Washing Methods

Source: Field Data, 2018

5.5.6. Drivers of Car Washing Methods

The most common driver for choice of car washing practice in Ndeke was the cost saving measure (56.1%) while for Kansenshi it was easiness and fastness (48.3%) figure (5.15). Under convenience one of the women respondents from Kansenshi observed that;

"I wash the car from home because the garden boy cleans the car every morning before I go for work, hence it is very convenient and less expensive for me"

In Ndeke, most respondents were concerned about the cost that car washing comes with. Thus, most of them preferred to wash their cars using buckets at home because it was less expensive for them. They evaluated the outcome of washing the car from home as being less expensive. In Kansenshi on the other hand, the most dominant driver was easiness and fastness, and convenience. Respondents in Kansenshi felt that it was better for them to have their cars washed by their "gardeners" or domestic workers. Facilitating conditions played a role.

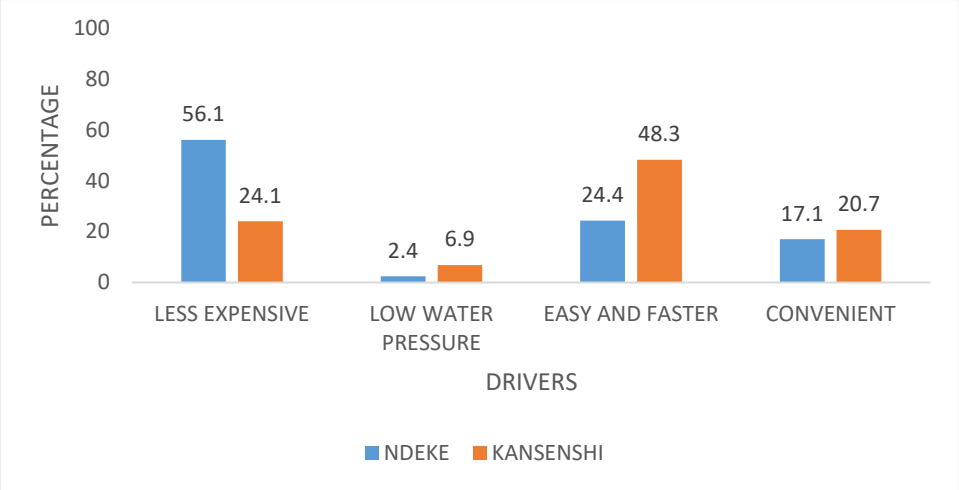

Figure 5.15: Drivers of the Car Washing Methods

Source: Field Data, 2018

5.6 Drivers of Domestic Water Use Practices and Triandi's Theory of Interpersonal Behaviour.

In relation to Triandis Theory of Interpersonal Behaviour, the drivers of domestic water use practices identified in this study are analysed as below;

Hygiene benefits are beliefs about outcomes. These shape the attitudes and result into intentions to carry an activity. Cost saving measures, easiness and fastness are valuation of outcomes. These also shape the attitudes that results into intentions and finally the behaviour. Tradition falls under frequency of past behaviour and norms. Norms are social factors that influences the intentions which result into behaviour, while frequency of past behaviour lead to habits that determine behaviour. Household fixtures and weather conditions are facilitating conditions. Enjoyment and comfort are emotions and finally convenience is self- concept (Table: 5.8)

Table 5.8: Drivers of the Water Use Practices in Ndeke and Kansenshi

THEORY COMPONENT	DRIVER TO WATER USE PRACTICE
Beliefs about outcomes (Attitude)	Hygiene benefits
Evaluation about outcomes (Attitude)	Cost Saving Measures, Easiness and Fastness, Enjoyment and Comfort.
Norms (Social Factor)	Tradition
Roles (Social Factor)	Convenience (social roles came into play as respondents mentioned that it was convenient for their Gardeners to wash the cars at home than to take to the car wash.
Self-concept (Social Factor)	Convenience
Emotions (Affect)	Enjoyment and Comfort
Frequency of Past behaviour (Habits)	Tradition
Facilitating Conditions	Household Fixtures, Weather Conditions and capacity to employ a gardener.

Source: Field Data, 2018

As shown above Triandi's Theory of Interpersonal Behaviour can be used to analyse drivers behind a particular behaviour including drivers behind domestic water use practices. This can help in determining core reasons for behaviour which is very significant for achieving success in a behavioural change intervention. The theory includes major components like habits and facilitating conditions which other behavioural change theories like the Theory of Reasoned Action do not provide for but were prominent drivers identified in this study. The theory allowed for in-depth understanding of the drivers behind the water use practices in the two study area. This can help in developing specific behavioural change programmes for Ndeke and Kansenshi aimed at promoting water conservation.

5.7 Level of Community Awareness on Water Conservation

Community awareness on water conservation is very vital if the water sector is to achieve sustainability and efficiency in the manner in which water is used in homes. The level of community awareness on water conservation can either have a positive or negative impact on how careful communities are when using water in their homes. The results of this study indicated that 65.9 percent of the respondents in Ndeke and 86.2 percent of the respondents in Kansenshi were aware about water conservation. A Two-Sample Z- Proportions Test indicated that level of awareness on water conservation was higher in Kanseshi compared to Ndeke (Table 5.9). These results were similar to Beal *et al* (2012) whose results indicated that high income households were more aware about water conservation.

Table 5.9: Level of Community Awareness on Water Conservation

	Ndeke (n=82)	**Kansenshi (n-56)**	**Test Statistics**
	Percentage of Respondents (%)	**Percentage of Respondents (%)**	
Level of Awareness	65.9	85.7	Z= - 2.83 (p= 0.002)

Source: Field Data,2018

Interviews conducted with KWSC revealed that the company conducts sensitisation programmes in the communities on water conservation. In the programmes, the communities are usually encouraged to employ more water efficient practices like the use of buckets when cleaning the cars, basins for washing the dishes, use of watering cans and buckets for garden watering and basins for bathing. The company also indicated that they encourage households to turn off the taps when not in use, fix leaking taps and report to the company any damaged water pipes.

Key informant interviews with WARMA also indicated that at district level the institution had been working with the city council to enhance water stewardship practices among the communities. WARMA indicated that this was done with support from other organisations including the German government through German International in Zambia (GIZ) and other stakeholders including the KWSC, Department of Water Affairs and private companies like Zambia Breweries.

NWASCO also indicated that at national level they do sensitise communities through television and radio programmes on household water conservation. However, this was not done in specific areas at community level. Key informant interviews conducted with NWASCO in Lusaka indicated that they had not decentralised their operations yet. Thus, it was difficult for them to work directly with the community. These finding suggest that the water resources management regulators did not adequately address issues of water resources management at household level. This indicated a gap in the measures being implemented to improve water efficiency and sustainability. Interviews with NWASCO and review of the NWASCO Strategic Plan 2016-2020 and the National Water Policy 2010 revealed a gap as strategies on information dissemination and public engagement focus more on complaints handling, service level guarantee and ensuring efficiency and sustainability of service provision by the Commercial Utilities, but there was no strategy for enhancing efficient water use by the consumers. In as much as it was indicated in the NWASCO sector report for 2016 that advocacy and sensitisation to instil a water conservation culture among the consumer is vital for combating water insecurity, there were no clear-cut strategies and activities in the strategic plan to address the issue. Also there were no strategies being implemented or stipulated in the strategy and policy document to promote businesses dealing in water efficient appliance.

On methods of community awareness on water conservation, the communities indicated the following methods; television, radio, school, sensitisations from Kafubu Water and Sewerage Company and reading. The most popular method of awareness in both areas was through television. Only 7.3 percent of the respondents in Ndeke and 6.9 percent of the respondents in Kanseshi got to know about water conservation through the water utility company (KWSC). This suggests that the water utility company could do more in terms of sensitisation on water conservations around the homes.

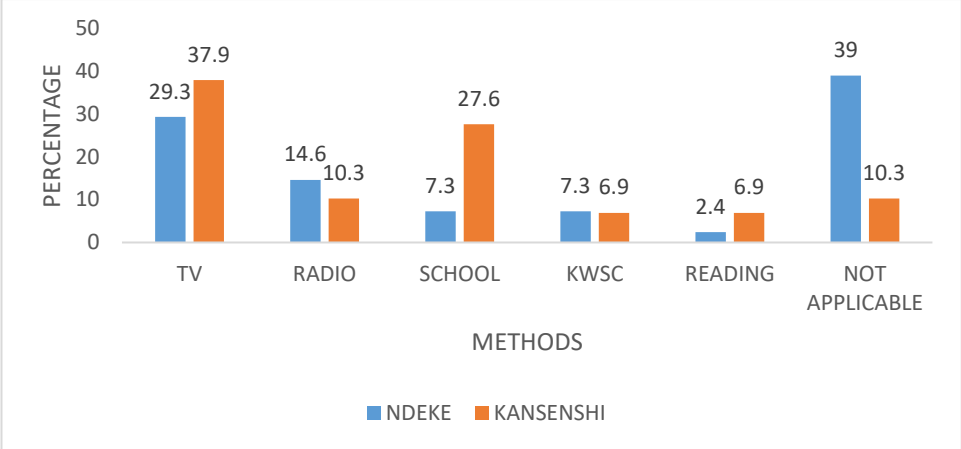

Figure 5.16: Method of Community Awareness on Water Conservation

Source: Field Data

There were more respondents in Ndeke (39 percent) that stated that they had not heard about water conservation than in Kansenshi (10.3 percent). This could be because the residents of Kansenshi had more access to television sets compared to Ndeke residents or that the reading culture and the culture of going to school was better in Ndeke than Kansenshi.

5.8 Community Understanding of the Term Water Conservation

Community understanding of the term 'water conservation' was that water conservation meant to; use water wisely, to save water and to use water efficiently. Only 17.1 percent of the respondents in Ndeke and 6.9 percent of the respondents in Kansenshi said they did not know what the term water conservation meant (figure 5.17). From the responses, it can be stated that the level of community understanding of the term "water conservation" in both areas was good. The findings were similar to (Rohilla *et al.*, 2017) who defined water conservation as any action that reduces the amount of water withdrawn from water supply sources, reduces consumptive use, reduces loss or wastage of water, improves efficiency of water use, increases recycling and reuse of water, or prevents pollution of water. Based on this definition by Rohilla *et al*., (2017), it can be stated that generally the residents in both areas had the correct understanding of what the term water conservation meant. In this study the residents of Ndeke a High cost residential area were more aware about water conservation than the residents of Kansenshi a medium cost area.These results were similar to Beal et al

(2012) whose results indicated that high income households were more aware about water conservation.

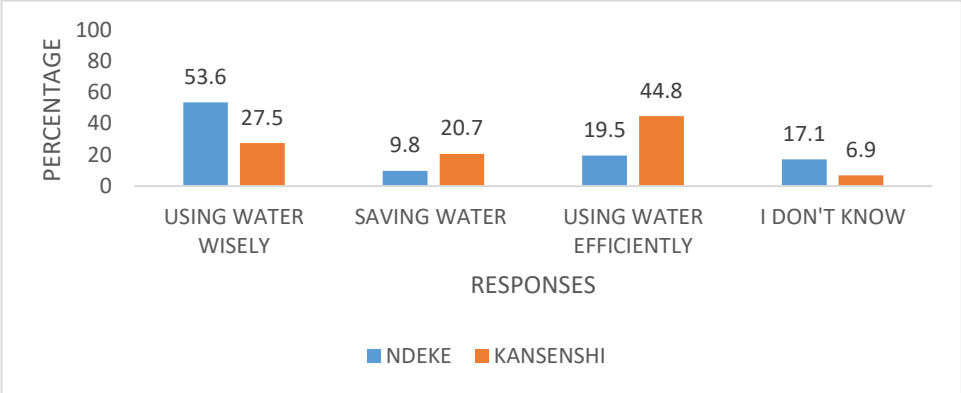

Figure 5.17: Community Understanding of the Term Water Conservation

Source: Field Data, 2018

5.9 Water Conservation Measures Practiced in Ndeke and Kansenshi

To conserve water in the homes, respondents mentioned that they ensure that all leakages are fixed, they close taps when not in use and they used cups and basins as opposed to using running water (Figure 5.18.). These results indicated that the communities were aware of some of the ways in which they can avoid wasting water around the homes.

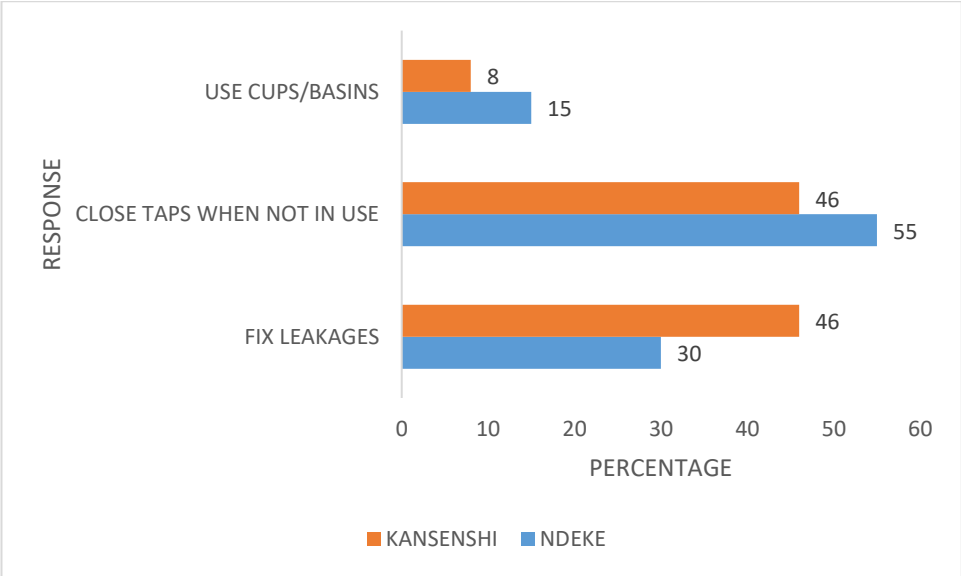

Figure 5.18: Water Conservation Measures Practiced In Ndeke and Kansenshi

Source: Field Data, 2018

In terms of rain water harvesting, 48.8 percent of the respondents in Ndeke and 51.2 percent of the respondents in Kansenshi practice rain harvesting. All the respondents that practiced rain water harvesting in both areas used buckets and basins to fetch water from the roofs. No major rain water harvesting technologies such as connection of water tanks to the roofs and in-let pipes to the homes were in place in both areas.

Key informant interviews with KWSC revealed that the company had not observed any major rain water harvesting technologies being implemented in the communities. The company also did not have any programmes to promote large scale rain water harvesting among the residents. However the key informant noted that rain water harvesting is a very sustainable technique that should be encouraged because it would help to reduce the amount of treated water that was used for non-consumption uses such as watering lawns and flushing of toilets. It was observed that a lot of treated water is wasted on non-consumptive uses and that this could be reduced if residents adopted rain water harvesting.

5.10 Water Challenges in Ndeke and Kansenshi

Various challenges relating to water were revealed in the two study sites (Figure 5.19). On the side of the provider (KWSC), the key informant noted a number of challenges that the company was facing in its daily operations. The challenges mentioned were vandalism of water pipes, illegal connections of water and leakages that resulted into high levels of non-revenue water and water contamination.

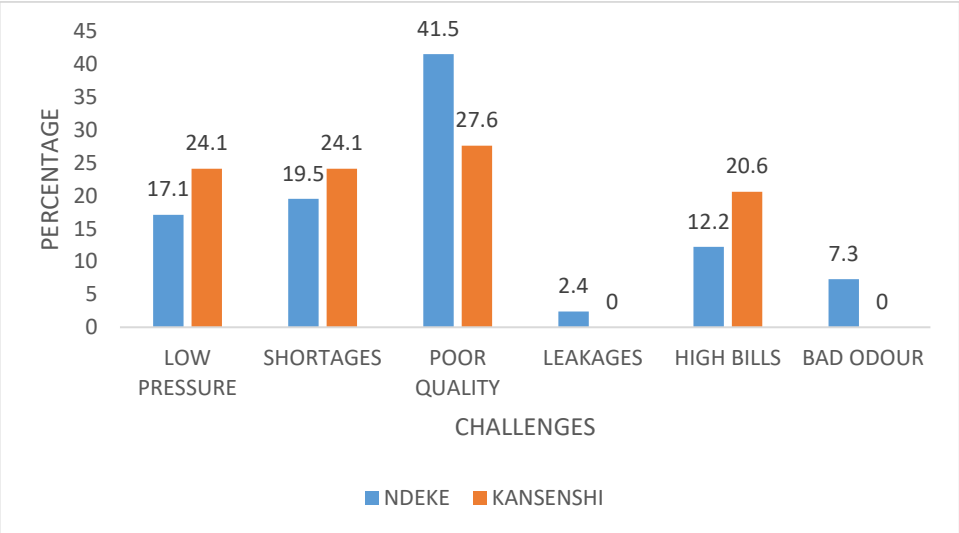

Figure 5.19: Water Challenges Faced by the Residents of Ndeke and Kansenshi

Source: Data,2018

On the side of the residents, leakages and bad odour were only prevalent in Ndeke. This could mean that vandalism prevalence in Ndeke is high, thereby causing water contamination that results into bad odour. The prevalence of leakages in Ndeke could also be contributing to the challenge of poor water quality (41.5 percent) in Ndeke. NWASCO (2017) indicated that the water infrastructure in Ndola was very old and was under rehabilitation in most areas.

In terms of resolving the water challenges, the key informant from KWSC mentioned that the company did not have a functional help line used for reporting defects and that the average time for repair of defects once reported was estimated at 8 to 24 hours. However from the part of the community, a very low percentage of respondents stated that KWSC was involved in resolving water challenges in the areas. In Ndeke only 9.8 percent of the respondents stated that KWSC assisted in resolving water challenges while 20.7 percent stated the same in Kansenshi. These results indicated that the water utility company (KWSC) was not seen to be very responsive to rectifying water problems in their areas of operation.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

In line with the research findings highlighted in the foregoing chapter, this chapter therefore draws the following conclusion on each objective. Further the chapter gives recommendations for both future research and application.

6.2 Conclusion

There were statistically significant differences in the proportion of respondents using the bath tub and bucket for bathing, cup and tap for teeth brushing, hosepipe and sprinkler use for garden watering and basin and tap for dish washing in Ndeke a medium cost residential area and Kansenshi a high cost residential area, hence the conclusion that water use practices vary from place to place. For example in the cold season, use of a bucket instead of a shower for bathing may become more common because water for bathing is being heated from the buckets. On the other hand, use of a shower may be preferred because it could be believed to be more hygienic than the use of a bath tub. Also an individual may decide to be more careful in the manner in which they use water because they want to reduce on water bills. These differences also imply that water managers must first understand how water use practices are being carried out and why they are being conducted in a particular manner for them to develop applicable domestic water conservation strategies. Water use practices must be fully understood in order to adequately identify opportunities for water conservation if the domestic water sector is to achieve sustainability and efficiency and reduce on wastage of the water resource. On the part of the counsumer, understanding domestic water use practices can help them to identifyand adopt more conservative methods. This can help them to manage water consumption and reduce on water bills.This study revealed a lot of gaps which if addressed could improve water efficiency in the two study sites. The residents of ndeke a medium cost residential area could be using less water for bathing, brushing of teeth, dish washing and garden watering than the residents of kansenshi a high cost residential area as they employed more conservative methods like use of cups, basins and buckets.

Domestic water use practices in the two study sites related positively towards water conservation as most respondents in both Ndeke and Kansenshi turned off their taps when not in use. The majority of the respondents in both areas were conscious about conserving water as they advised members of their households to close the taps when not in use. This result could have been because residents from both areas were mindful

about how much water they used because they wanted to reduce on the water bills which they perceived to be very high. This implies that water metering is an effective water management strategy that can promote water conservation. However , focus must also be made on educating the community on the environmental benefits of water conservation.

There was no statistically significant difference in the proportion of respondents who accessed water from Kafubu Water and Sewerage Company in the two areas. However, the level of community awareness on water conservation was higher in Kansenshi than in Ndeke. Average monthly income was higher in Kansenshi than in Ndeke and that monthly payments for water was higher in Kansenshi. Therefore more sensitisations on water conservation has to be conducted in Ndeke.

The drivers of domestic water use practices were identified. These drivers included environmetal drivers i.e. wheather conditions, economic factors i.e. reduction of water bills and social factors i.e. availability of gardeners. Facilitating conditions like household fixtures and garders and habits such as traditions also played a role. These where in line with Triandis' Theory of Interpersonal Behaviour. Other drivers of domestic water use practices included enjoyment, easiness, fastness, convience and hygiene benefits among other. This indicated that indeed a multiple of factors come into play in determining behaviour.

6.3 Recommendations

1. The prevalence of water use practices varied in the two areas. Therefore players in the water sector such as water utility companies must invest in understanding the domestic water use practices that are being employed in a particular area for them to adquately identify opportunities for water conservation in a areas. This can been done by conducting reseach and increasing budgetary allocation and funding for research in the sector.
2. The residents of Ndeke a medium cost residential areas used more conservatives methods like cups, buskets and basins during bathing, tooth brushing and dish washing. Theres more sensitisation must be conducted in high cost residential areas on water conservation during the above stated

practices. Relevant authorities such as Local Authorities and Water Utility Companies must design and implement community sensitisation programme to promote household water efficiency.

3. In both areas communities were mindful about conserving water because they water to reduce on water bills. Therefore more emphasis must be made on education the communities on the environmental benefits of water conservations.
4. Various factors interact in determining water use behaviors. These factors (drivers) must be fully understood by water managers for them to effectively design behavioral change programmes the promote water conservation. Therefore the government must increase resources allocation for conducting research in this area.
5. The study recommends that future research may focus on examining the influence of household income and households size on water consumption in the two study areas.

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APPENDICES

Appendix A

QUESTIONNAIRE ON THE DOMESTIC WATER USE PRACTICES OF THE HOUSEHOLDS OF KANSENSHI AND NDEKE RESIDENTIAL AREAS OF NDOLA CITY IN ZAMBIA.

Serial No: …… Place: ……. Date: …….

Ms Vwambanji Namuwelu is carrying out a research in Kansenshi and Ndeke townships of Ndola on the domestic water use practices in these areas. This is in partial fulfilment of the requirements for the degree of Master of Science in Environmental and Natural Resources Management with the University of Zambia.

You are therefore requested to answer all the questions to the best of your knowledge and kindly be assured that the information will be kept confidential.

SECTION A: DEMOGRAPHIC AND BACKGROUND INFORMATION

1. Sex of Respondent , Male: …… Female: …….
2. Age: ……years
3. How many are you in your household? ……..
4. What is your highest educational attainment?
    (a) Lower Primary 1-4 …….
    (b) Upper primary 5-7 …….
    (c) Junior Secondary 8-9 ……
    (d) Senior Secondary 10-12 …….
    (e) Tertiary……
    (f) None …….
5. What is the average combined income level for your household?
    (a) 1 000 to 5 000
    (b) 5 000 to 10 000
    (c) 10 000 to 15 000
    (d) Above 15 000
    (e) Below 1000
6. For how long have you lived in this area? ……..
7. What is the source of your water?

(a) Borehole

(b) KWSC water

(c) Others specify

8. Do you have water available 24 hours 7 days a week?

(a) Yes

(b) No

9. If no to question 8, What are your others sources of water?

(a) Rationing

(b) Other sources specify ……

10. If the answer to question 9 is (a) is the water rationing…….?

(a) Erratic

(b) Periodic (state the period if it is known eg 03hrs to 06:hrs)

11. How do you store your water?

(a) Drums

(b) Bath tub

(c) Reserve Tank

(d) Others specify

SECTION B: PERSONAL HYGIENE

12. What do you use for bathing?

(a) Shower ……. (b) Bath tub…… c) Bucket in shower/tub. .. ..

13. What is the reason for your answer in question 12?
……

……
……
…….

14. If the answer to question 12 is (a), Do you leave the shower open while you scrub your body?

(a) Yes …… (b) No …….

15. Are the members of the household told not to leave the water running when taking a shower?

(a) Yes……. (b) No ……..

16. Do you uses recycled water or KWSC water for toilets flushing?

(a) KWSC water…… (b) Recycled water …….

17. If the answer to question 16 is (b) were does the recycled water come from?

……
….

18. What do members of the household use to brush their teeth?

(a) Cup…… (b) Tap …….

19. if (b) to question 18. Are taps left to run while people brush their teeth?

(a) Yes …….. (b) No …….

20. Are the members of the household advised not to leave the tap running while they brush their teeth?

(a) Yes …….. (b) No …….

SECTION C: LAUNDRY

21. What do you use to do your laundry?

(a) Tap using basin ……. (b) Washing Machine ……. (c) Bath tub …….. (d) Outside wash Sink ……..

22. What is the reason for the answer in question 21?
……

……
……
…….

23. If the basin is under a tap, do you leave the tap open while you rinse your clothes?

(a) Yes ……. (b) No ……

24. If the answer to question 21 is (d), do you leave the tap ruing when washing?

(a) Yes ……. (b) No…….

25. Are the members of the household advised to close the tap while they are rinsing?

(a) Yes ….. (b) No ……..

26. Is rinsing water used for any other purpose after washing e.g watering the lawn? Specify? ……

SECTION D: GARDENING

27. What do you use to water the garden?

(a) Watering can…… (b) Bucket……. (c) Sprinkler ……. (d) Hosepipe …… (e) drums …….

28. What is the reason for the answer to question 27 ?

……
……
……

SECTION E: DISH WASHING

29. How do you wash your dishes?

(a) Basin…… (b) In sink with running tap …… (c) Dish washing machine …….

30. What is the reason for the answer in question 29?

……
……
…….

31. Are the members of the household advised not to wash the dishes under a running tap?

(a) yes …….. (b) No ……..

SECTION F: CAR WASHING

32. Where do you wash your vehicle from?

(a) Home ……. (b) Car Wash ……

33. What is the reason for your answer in question 32?

……
……..

34. If the answer to question 32 is (a), what do you use to clean the car?

(a) Bucket ……. (b) Hosepipe …….

35. If the answer to question 32 is (b), do you close the water tap while you scrub the car?

(a) Yes …… (b) No …....

36. Are the members of the household told not to leave the tap running while they wash the car?

(a) Yes …….. (b) No

SECTION G: WATER CONSERVATION

37. Are you aware of the term water conservation?

(a) Yes ……. (b) No …….

38. If yes to question 37, what do you understand by the term water conservation?

……
……
……

39. If yes to question 37, how did you know about water conservation?

……
……
…….

40. What measures do you put in place to conserve water in your home?

……
……
…….

41. Has anyone come to you or your community to talk about water conservation?

(a) Yes ……. (b) No …….

42. If yes to question 41, which organisation did they come from?

(a) LWSC …… (b) NGO ……. (c) Others specify …….

43. Do you harvest water in the rain season?

(a) Yes …… (b) No

44. If yes to question 43, how do you harvest?

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……

SECTION H: CHALLENGES IN THE WATER SECTOR

45. What challenges do you face in the water sector?

(a) Low pressure …… (b) Water shortages ……. (c) Poor quality water ……. (d) Leakages ……. (e) High bills …….. (f) Other specify…….

46. Does KWSC assist in solving these challenges?

(a) yes ……. (b) No …….

Appendix B

INTERVIEW SCHEDULE- KAFUBU WATER AND SEWERAGE COMPANY

1. Sex

   Male: …… Female: ……

2. How long have you been working for Kafubu Water and sewerage company? …….

3. What is your level of education?

   (a) Certificate…. (b) Diploma …. (c) Degree …. (d) Others specify ….

4. What is your position in the company?
   …….....
   .....

5. What is your professional qualification?
   ……

6. Do you have any campaigns on water conservation?
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   ……..

7. Do you have a help line call centre?
   ……
   ……
   …….

8. What is the average timeframe of repair form defects from the time they are reported?
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   ……..

9. Do you have a 24 hours' response programme for repair of defects or leakages?
   ……
   ……

10. How are you limiting the amount of un accounted water within your organisation?
    ……
    ……
    ……
    ……

11. What challenges are you facing in supplying water to the communities?
    ……
    ……
    ……

12. What is the company doing to try and solve these challenges?
    ……

……..

13. Have you been experiencing water shortages from your sources in the recent past?
    .....
    .....

14. What are the causes of these shortages?
    ……
    ……
    ……..

15. What are you doing to manage the water shortages? ……..

……
..

16. Is rain harvesting being practiced in Ndeke and Kansenshi?
    ……
    ……
    ……

Appendix C

INTERVIEW SCHEDULE- NWASCO

1. Name and Position of officer

…….....

……
……

2.What is your professional qualification?

……..

3. Do you conduct community programmes and sensitisations for promotion of domestic water conservation and use of efficient water appliances?

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4. Do you have initiatives that encourage sellers to import water efficient appliances at a cheap price?

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5. Do you have initiatives that encourage house owners to install water efficient appliances in their houses?

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6.Do your policies and strategies adequately address the issue of domestic water conservation?

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7.How are you working with other stakeholders to ensure water conservation at household level?

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Appendix D

INTERVIEW SCHEDULE- WARMA

1. Name and Position of officer

…….....

……
……

2. What is your professional qualification?

……..

3. Do you conduct community programmes for promotion of domestic water conservation and use of efficient water appliances?

……..

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…….

4. Do you have initiatives that encourage sellers to import water efficient appliances at a cheap price?

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5. Do you have initiatives that encourage house owners to install water efficient appliances in their houses?

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6. Do your policies and strategies adequately address the issue of domestic water conservation?

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6. How are you working with other stakeholders to ensure water conservation at household level?

   ……
   ……
   ……

8. What are the various water sources observed in the two study areas?

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Appendix E

SAMPLE SIZE CALCULATION

To achieve a 95% confidence level and positive precision level (p-value) (d=.05, Z = 1.96) then:

Sample size for Ndeke was;

$$n = \frac{105*3.8*0.25}{(0.0025*104) + (3.8*0.25)}$$

$$= \mathbf{82.125}$$

Sample size for Kansenshi was;

$$n = \frac{62*3.8*0.25}{(0.0025*61) + (3.8*0.25)}$$ Equation 2

$$= \mathbf{55.61}$$