Water Borne Diseases: A Cry of a Trapped Community

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WATER BORNE DISEASES: A CRY OF A TRAPPED COMMUNITY

By

Passmore Mudundulu

A THESIS

Presented to the Faculty of
The Graduate College at the University of Nebraska
In Partial Fulfillment of Requirements
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Major: Community and Regional Planning

Under the Supervision of Professor Robert Kuzelka

Lincoln, Nebraska

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The purpose of this study was to understand the problem of attaining safe and clean water that has contributed to high incidence of water borne diseases and to investigate its effects on the residents of Chawama Township, Lusaka, Zambia. A survey was used to collect data from 400 male and female participants to determine their source, treatment and storage of water; sanitary facilities; attitude, experience and knowledge of waterborne diseases. Findings indicated that, the most common source of water was communal city taps and residents did not boil or add chlorine to make it safe for use, making it susceptible for them to contract waterborne diseases. Pit latrines were the common type of toilet facility residents used. Almost all of the participants had a wide knowledge of waterborne diseases particularly cholera and diarrhea. An understanding of the link between unsafe water and waterborne diseases can be useful to the decision makers for planning, management and evaluation of water supply policies.
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1. CHAPTER ONE - INTRODUCTION

1.1 Water Related Health Issues

Access to safe and clean water is important as a health and development issue at national, regional and local levels (World Health Organization 2006). Throughout human history, the major problems of health that humans have faced have been concerned with community life such as the control of transmissible diseases, and the provision of safe and clean water in sufficient supply (Rosen 1993). The Romans, for instance, in spite of the remarkable achievement in public health engineering still had to cope with the problem of endemic and epidemic water borne disease such as typhoid fever and dysentery (Rosen 1993).

Furthermore, each year, an estimated 2.5 billion cases of diarrhea occur among children under five years of age, with more than half of these cases occurring among populations in low-income regions of South-East Asia and sub-Saharan Africa, Figure 1.1 (UNICEF/WHO 2009).
This document is divided into six chapters. The first chapter describes the purpose and background of the study. Chapter two presents a review of literature on the problem of attaining safe and clean water that has contributed to high incidence of waterborne diseases among the residents of Chawama Township in Zambia. The water resource in Zambia is discussed in chapter three. Chapter four details the research design and application of the survey, including theoretical model and methodology. Chapter five presents the results of the survey. Chapter six is a discussion of the results, and recommendations.
1.2 Background of Zambia

Historical and Archeological evidence indicates that by the year 1500, Zambia was occupied by Bantu- speaking horticulturists and subsistence farming people who are ancestors of its present inhabitants. Between 1889 and 1924 the British South Africa Company established by Cecil Rhodes, governed the region under the mandate of the British government. In 1911 the territory was named Northern Rhodesia. In 1924 the British government assumed direct control over Northern Rhodesia, and it officially became an established protectorate. On October 24, 1964 Northern Rhodesia gained and declared independence as a nation state of Zambia (Northern Rhodesia 1964).

Zambia is situated in the tropical region of the sub-Saharan Africa, the axis of the waterborne diseases, where it has been reported that the burden of these diseases is a major concern (Negri 2005). The problem of attaining safe water supplies has led residents to experience high incidence of waterborne diseases some of which lead to death. For example, in 2004, a cumulative total of 4,734 cholera cases were reported in the city of Lusaka, with 212 deaths (Central Statistical Office 2006).

The 2000 Census report indicated that at National Level, only 49.1 percent of households in Zambia had access to safe water (Central Statistical Office 2002).

1.2.1 Geography

Zambia is situated in southern Africa, landlocked and surrounded by eight countries namely, Botswana, Democratic Republic of the Congo, Angola, Namibia, Zimbabwe, Mozambique, Malawi, and Tanzania (Figure 1. 2).
Figure 1-2 Location map of Zambia (source: WorldAtlas.com)

Zambia has a total land area of 752,614 square kilometers. The landlocked terrain of Zambia consists mainly of a high plateau with some mountains and hills. The elevation varies from greater than 2300 meters in the Mafinga Hills on the northeast national border, down to 329 meters in the valley of the Zambezi River (UN Report 1989).

The climate is tropical with variations depending on altitude. Annual rainfall averages 1010 mm, ranging between 750 and 1400 mm, and increases progressively from south to north. A distinct rainy season occurs from October to April. Average daily
temperatures are around 18 to 20°C during the cool dry season (from May to August) and 35°C during the hot dry (from September to November) are common particularly for low-lying regions such as the Zambezi and Luangwa valleys (UN Report 1989). It is endowed with good water resources, mainly from the rivers, lakes, wetlands, and groundwater. For instance, the basin of the Zambezi River covers around three-quarters of the country.

Zambia has a centralized system (Republic) of government divided into ten provinces, and 73 districts. The provinces are Central, Copperbelt, Eastern, Muchinga, Southern, Luapula, and Lusaka; Northern, North-western, and Western (Figure 1.3) (Central Statistical Office 2011.)

![Figure 1-3 Provincial Map of Zambia (Source: Zambians.com)](image)
1.2.2 Population

Zambia’s population was first comprehensively recorded at 5.7 million in 1980. It increased to 7.8 million in 1990, 9.9 million in 2000, and 13.01 million people in 2010. This gives an annual growth of 2.8 percent between 2000 and 2010; with Lusaka Province having the highest average population growth rate of 4.7 percent yearly (Central Statistical Office 2011).

Zambia is one of the most urbanized countries in southern Africa; between 35 and 40 per cent of the population live in urban areas, with an urbanization rate estimated at 2.3 percent annually between 2005 and 2010.

1.2.3 Economy

Zambia has a mixed economy consisting of a modern urban sector that, geographically, follows the rail line and a rural agricultural sector. Copper mining is the country’s main economic activity accounting for 95 percent of export earnings and contributing 45 percent of government revenue during the decades following independence (1965-1975). In the mid 1970s following a sharp decline in copper prices and a sharp increase in oil prices, the country’s economy deteriorated (Zambia Demographic and Health Survey 2003).

The country suffers from high levels of extreme poverty, with an estimated GDP per capita at purchasing power parity of US$1500 in 2009. Excess mortality due to AIDS has reduced life expectancy to just 39 years, and the population’s median age is 17 years (Central Statistical Office 2002). The low sanitation levels and limited access to safe and clean water in many urban areas resulting from high population densities and low investment levels is critical, and a serious threat to public health. The rising rate of
population growth for example is not rising at the same pace with the current water supply infrastructure; hence, rendering it to be inadequate to cater for this rising population, and this has posed a public health concern. Subterranean pollution and dilapidated Water Supply and Sanitation systems connecting with each other lead to a public health risk which is worse in towns than in rural areas (Nyambe and Feilberg 2009).

This rapid population growth, urbanization and weak economy makes access to safe and clean water supply more difficult, hence, a risk for outbreaks of waterborne diseases. The current water supply infrastructure is not adequate to cater for the growing population.

1.3 Statement of the Problem

The link between the problem of attaining safe and clean water and high incidence of water borne diseases has not been clearly understood. This is a serious problem that affects people world over, national as well as in local communities, but those living in the third world are especially the most impacted. According to the World Health Organization (2004), 45 countries reported cholera outbreaks in 2003, with a total of 111,575 cases and 1,894 deaths, and 97% of these reported cases occurred in sub-Saharan Africa.

The purpose of this study was to understand the problem of attaining safe and clean drinking water that has contributed to high incidence of water borne diseases some of which lead to death, for the inhabitants of Chawama Township, Lusaka, Zambia. Personal characteristics were divided into participant demography (Level of education, gender, age, marital status, and number of people in household). The examination of
demographics was important to this study because it was used to compare with other constructs contributing to the problem of attaining safe water and incidence of waterborne diseases (Creswell 2003). The second part of the study asked participants to identify their source of drinking water. Source of water was defined by the following elements: how long it took to get the water from source; how it was stored; treatment before drinking (boiling or chlorination), toilet facilities and use of toilet facilities (household or/and share with neighbors). The last components asked participants about knowledge and experience of incidence of waterborne diseases.

The problem of attaining safe and clean water places an enormous burden of waterborne diseases on the health of the citizens, particularly on the health of children. For instance, the 1996 Zambia Demographic Health Survey showed that 24 percent of children under-five years of age experienced diarrhea in the two weeks preceding the survey (Central Statistical Office 1996). Chege and Agha (1999) reported that the incidence of diarrhea among children in Zambia’s low-income neighborhoods was about 42% higher than the national (urban) level.

Access to safe and clean water is an important component to health. Polluted water can be transported rapidly during floods and can end up in the drinking water sources. Zambia’s water pollution from human activities has apparently been on the increase (Museteka and Bäumle 2009).

Water borne diseases such as cholera, occurs and spreads fast during the rainy season causing sicknesses and deaths (Table 1.1).
Table 1-1 Number of Cholera cases and deaths 1991-2004 in Zambia

<table>
<thead>
<tr>
<th>Year</th>
<th>Cholera cases</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>13,154</td>
<td>-</td>
</tr>
<tr>
<td>1992</td>
<td>11,657</td>
<td>-</td>
</tr>
<tr>
<td>1993</td>
<td>11,327</td>
<td></td>
</tr>
<tr>
<td>2003/2004</td>
<td>2,529</td>
<td>128</td>
</tr>
</tbody>
</table>

Source: Museteka and Baumle

Similarly, an accumulative of 34,271 cholera cases (nationally) was reported between 1999 and 2006 (National Water Supply and Sanitation Council 2006). These cholera cases were attributed to unclean environments and mostly due to ingesting contaminated water drawn from shallow wells (Sack et al. 2004). Zulu and Nyambe (2004) showed that the high prevalence rates of cholera were related to the interaction between pit latrines and the unprotected shallow groundwater wells used for domestic purposes including drinking.

1.4 Significance of the Study

Understanding the problem of attaining clean and safe water that contributes to incidence of waterborne diseases is important for several reasons. First, understanding the link between unsafe water and diseases can help promoting preventive attitudes and practices among water users. Second, the findings were useful to water providers for planning, management and evaluation of water supply services. Third, the information was helpful to health systems plan intervention strategies to curb the problem of waterborne diseases. Fourth, the study provided opportunities for future studies to fill in the
gaps that this study could not address. Fifth, these studies added to the existing body of knowledge on water related diseases and play a vital role in providing people with information on public health. Finally, this study highlighted the problem of attaining safe water, and then developed and made recommendation to policy and decision makers on how best the water supply can be improved.

1.5 Research Questions

(1) What was the main source of water supply for people in Chawama Township during the study period?

(2) How was the water treated and stored before use?

(3) What type of toilet facilities existed and how were they used in Chawama Township during the study period?

(4) Are people in Chawama Township knowledgeable about waterborne diseases?

(5) Did any of the study participants or household members, or neighbor suffer from any of the waterborne diseases listed on the questionnaire?

1.6 Objectives

(1) To determine the households’ vulnerability to waterborne diseases attributed to the problem of attaining safe and clean water.

(2) To identify the participants’ source(s) of water, storage, and treatment

(3) To determine the participants attitudes and knowledge of waterborne diseases

1.7 Definitions

Waterborne disease is a disease caused by the ingestion of water contaminated by human or animal feces or urine containing pathogenic bacteria or viruses.
Drinking water is water used for domestic purposes such as drinking, cooking and personal hygiene.

Household is a group of persons who normally eat and live together. These people may or may not be related by blood, but make common provision for food and other essentials for a living. It may comprise one or several members.

Access to water: In urban areas a distance of not more than 200 meters from a home to a public water source.

Access is actual use by the population.

Clean Water is water which is pure enough to be consumed or used with low risk of immediate or long term harm.

Safe water is water that does not contain biological or chemical agents directly detrimental to health. It includes treated surface water and untreated but uncontaminated water from protected springs, boreholes.

Dysentery is an inflammation of the intestine characterized by the frequent passage of feces with blood and mucus.
2 CHAPTER TWO - REVIEW OF LITERATURE

2.1 Introduction

This chapter describes literature reviewed for research purposes of this thesis. The search employed library sources, the Internet’s World Wide Web, and locally published documents obtained from Zambia.

The literature review was guided by the questions in the questionnaire. For example, information was sought to provide information on source of drinking water for members of households. The chapter is organized into three sections: (1) development of water resource (2) Access to safe water, and (3) waterborne diseases.

2.2 Development of water resource

The literature on the development of water resources acknowledges the importance of adequate and safe water for human health, economic production, and sustainable development (Walton 1970; King 1953). Failure to ensure the provision of clean and safe water could expose citizens to the risk of contracting waterborne diseases.

Humans have been concerned with managing water as a necessity of life and as a potential hazard at least since the first civilizations developed (Dingman 2002). Centuries ago, for instance, canals, dams, and wells were built along major rivers such as the Indus in Pakistan, the Tigris and Euphrates in Mesopotamia, the Hwang Ho in China, and the Nile in Egypt as early as 5,000-6,000 years BC in an effort to capture and store water (Biswas 1970).

Zambia has made some efforts in dealing with the water supply for its citizens. These efforts have been in a form of regulatory provisions and physical structures. For
instance, there are more than 1,500 dams constructed countrywide with total water storage of $200\text{km}^3$ for purposes of domestic use and energy generation (National Water Law 1994). Also, the Water Sector Policy and Legal Reforms were introduced to protect water source and quality. In 1994 for instance, the National Water policy was adopted to address issues of water resources. Its objective was to promote sustainable water resource development with a view of facilitating adequate, equitable and good quality water supply at all times for all of the users (National Water Resources Report 2009).

2.3 Access to safe water

The lack of access to safe and clean water is a serious problem. The WHO (2000) estimated that 1.1 billion people worldwide lack access to “improved water supply” while Hunter et al. (2000) reported that, about 20 percent of the world's population lack access to safe drinking water.

Although all nations have deficiencies in providing adequate supplies of safe water for domestic use, the problem is most critical among the developing countries (Walton 1970). UNICEF (2000) estimated that in 50 percent of the developing countries, the majority of the populations have no access to adequate safe and clean water. Furthermore, UN Population Division (2004, 68) reported that of 117 countries with data available in developing nations, the majority of the population lack access to safe drinking water.

Although the problem of lack of access to safe water supply exists among many regions of the world, Sub-Saharan Africa is experiencing its devastating impact first-hand. UN-HABITAT Report (2011) indicated that an estimated 150 million Sub-Saharan African urban dwellers do not have access to safe drinking water supplies. It is also
estimated that in Sub-Saharan Africa, more than 300 million people lack access to safe drinking water supply (Yongsi 2010, 424).

Within the context of cities which are witnessing constant population growth, access to safe water remains a challenge to many inhabitants. The population growth and peri-urban sprawling, has made it hard for Zambia to provide clean and safe piped water to everyone. This failure has led to many urban dwellers resorting to obtaining water from unsafe sources such as hand-dug shallow wells. Water from such sources is often contaminated with fecal material, domestic and industrial wastes. Such polluted water results in an increased public health risk of waterborne diseases outbreaks (Mahvi and Karyab 2007).

In Zambia, access to safe and clean water is similar to many other developing countries. The 2000 Census estimated that at national level, only 49.1 percent of households had access to safe water (Central Statistical Office 2000). The United States Agency for International Development (2006) survey estimated that only 52 percent of the population had access to safe and clean water. This percentage of access to clean water was higher than the average in Sub-Saharan Africa (International Network for Environmental Justice in Africa 2010).

### 2.4 Morbidity and Mortality Waterborne Diseases

Although waterborne diseases have largely been eliminated in developed nations, the burden of these diseases remains a major concern in many developing countries, particularly in tropical regions (Gleick 2002).

Water-borne diseases are basically “dirty-water” diseases; mainly attributed to water that has been contaminated by human, animals or chemical wastes (Chabalala and
Mamo 2001). Worldwide, it has been shown that water-borne diseases are responsible for over 2-3 million deaths a year mainly due to lack of safe drinking water (UNICEF/WHO 2009). Waterborne diseases among others include dysentery, cholera, diarrhea, and typhoid fever.

More importantly, vulnerable groups, such as children, women, immune compromised people such as AIDS patients, and the elderly, are the most impacted. There is evidence in literature that shows a relationship between contaminated drinking water, and waterborne diseases. For example, drinking water, which is contaminated by human or animal feces, can result in contracting waterborne diseases, such as cholera, dysentery, and typhoid fever, and diarrhea (Tumwine et al. 2002, 7).

According to the UNICEF/WHO (2009), waterborne diseases, such as diarrhea, remains the second leading cause of death among children under five globally. Worldwide, it is estimated that 140 million people develop dysentery each year, and about 600,000 die (Perlin & Cohen 2002). In the United States of America, waterborne disease outbreaks have been caused mainly by contaminated wells and water storage reservoirs. For instance, in 1993, an outbreak of “S. Typhimurium” resulted in 650 illnesses and 7 deaths in Missouri (Covert 1999).

Furthermore, it is estimated that nearly one in five children’s death, that is about 1.5 million each year is attributed to diarrhea, thus, killing more young children than AIDS, Malaria and Measles combined (UNICEF/WHO 2009). It is also estimated and reported that diarrhea kills 1.8 million and causes approximately 4 billion cases of illness annually, of which 88% is attributable to unsafe water (WHO 2007). The Center for Disease Control (2007) reported that Typhoid fever is still common in the developing
world where it affects about 21.5 million persons each year. Hall and Lobina (2008) reported that 2.2 million deaths in developing nations are attributed to waterborne diseases. Almost half of the population in developing countries is at high risk of exposure to waterborne diseases such as dysentery, typhoid fever, and cholera (Suresh and Smith n.d.).

Diarrheal epidemics have been common in many world regions. For example, a four-year epidemic in Central America, starting in 1968, resulted in more than 500,000 cases and more than 20,000 deaths. Since 1991, dysentery epidemics have occurred in eight southern African countries of Angola, Burundi, Malawi, Mozambique, Rwanda, Tanzania, Zaire, and Zambia (Perlin and Cohen 2002). Currently, the island nation of Haiti is in a cholera epidemic which has reportedly killed more than 4,000 people and infected 217,000 people (Tuite et al. 2011).

In sub-Saharan Africa, a region in which Zambia is located, diarrheal diseases are a leading cause of death in children under five years. It is estimated that each child has five episodes of diarrhea per year and that 800,000 of those children die from diarrhea and associated de-hydration (Perlin and Cohen 2002).

In Zambia, the United States Agency for International Development Water and Sanitation Profile 1 (2006) estimated that diarrheal deaths in 2004 were 13,700; furthermore, cholera epidemics have occurred every year in many parts of the country leaving hundreds dead and many thousands more passing through the ordeal of the infection. For instance, a total of 6,542 cholera cases and 187 deaths were reported in Lusaka between November 28, 2003 and June 8, 2004 (Sasaki et al. 2008).
2.5 Summary

Study reports cited above clearly show that water-borne diseases are a serious public health threat, particularly in developing countries. Negri (2005) reported that water-borne diseases are number one killer in the tropical regions of Africa. The studies reviewed above also addressed outbreaks in different countries including Zambia, whereas this study focused on data collected in Chawama Township, Lusaka. Unless the problem of attaining safe and clean water is adequately dealt with, incidence of waterborne diseases will continue impacting young children and the elderly particularly in less developed nations.
3  CHAPTER THREE - WATER RESOURCES IN ZAMBIA

3.1  Introduction

In Zambia, available water in any particular area depends on how much surface water and groundwater is available. The current water resource potential estimate for 2005 was 186.65 \( \text{Km}^3 \). Although it appears sufficient and of relatively good quality to meet both present water demands estimated at 40 \( \text{Km}^3 \), the population has almost doubled to 13 million (Central Statistical Office 2011) pausing a challenge to future demands for a growing population.

Nearly all discussions on water tend to underscore its importance to human life. Viewed from the Africa perception, water is a gift from the gods and unquestionably a substance that is part of humanity. Many ceremonies of birth and death rites in Africa and Zambia in particular revolve around water. For instance the “Malende” ceremony of the Tonga people in Southern province of Zambia is intended to invoke mercies of the gods to release the rains when there is a drought.

3.2  Water Use in Zambia

Zambia’s water resources are predominantly present in two forms, the surface water and groundwater. Although the country may be bursting with abundant water resource, the problem is that it may not all be in the form and quantity in which it can be utilized by the nation’s 13.01 million people.

The country’s largest amount of water is used for hydropower generation. The rest is shared among various sectors such as agriculture, industry, and domestic water supply including wildlife. According to an assessment made by Japanese International Cooperation Agency (1995), between 1992 and 1995, it was estimated that the total water
demand in Zambia was less than 40 Km$^3$. Of this water, 36 Km$^3$ per year (1,150m$^3$/s) is used for hydropower generation. Out of the remaining 3 Km$^3$ per year, agriculture uses about 2.31 Km$^3$, Industry 0.21 and households 0.48 Km$^3$ (Figure 3.1).

![Figure 3-1 Water Usage in Zambia (Source: JICA-MEWD, 1995)](image)

**3.3 Health Concerns/Impacts**

Zambia, with its ten provinces and 73 districts, is one of the most urbanized countries in Southern Africa with 40% of its population living in urban areas (Central Statistical Office 2008). The average population density in urban areas has continued to rise at every census period (Table 3.1).
### Table 3-1 Zambia’s average population density

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Population Density</td>
<td>5.4</td>
<td>7.5</td>
<td>9.8</td>
<td>13.1</td>
<td>17.3</td>
</tr>
</tbody>
</table>

Source: CSO 2004

Lusaka has the highest population density at 100.4 per square kilometer. As a matter of fact, this population explosion is concentrated mostly in Lusaka’s unplanned settlements or Peri-urban areas. The population density particularly in these unplanned settlements raises a serious public health concern because these areas are characterized by poor water supply and sanitation services, deteriorated environmental conditions, poor drainage, and uncollected solid waste (Nyambe and Feilberg 2009).

### 3.4 Hydrology

The rainfall range is from 600 mm in the south to 1500 mm in the north, falling between October and April, which is the wet season. This means, river flows in the country experience seasonal variations with peaks between March and April and the lowest flow is experienced between October and November. The Country is therefore prone to extreme meteorological events.

Renewable potential of surface water has been estimated to be just over 100 Km$^3$ while that of groundwater was estimated to be 49.6 Km$^3$ (Japanese International Cooperation Agency 1995). There has been no observed sign of groundwater depletion, but some aquifers such as the Lusaka aquifer are slowly coming under a threat from pollution due to exposure to pit latrines, and septic tanks (Nyambe and Feilberg, 2009).
The average annual evapo-transpiration is estimated at 1,574 mm and ranges between 1,394 mm and 1,892 mm (Japanese International Cooperation Agency 1995). This means, the country has a precipitation deficit of 100 to 1,100 mm per based potential evapo-transpiration.

In a high rainfall hydrological year, the annual runoff can be as high as 130 Km\(^3\) per year. It can also be as low as 68 Km\(^3\) in a severe drought year. This fluctuation is important because during the dry seasons, groundwater becomes a major source of water in sustaining the country’s river flows (Nyangbe and Feilberg 2009).

### 3.4.1 Surface water Drainage

Zambia, unlike many other countries in the region has more than adequate water resources. The nation lies entirely within two large river basins, the Zambezi and the Congo River basins. The river network is well distributed and well fed and it includes large and small watercourses with a total renewable water resource of 105 km\(^3\)/year (Matlock 2007). For instance, Zambezi River’s total drainage from source to mouth, occupies about 1.2 million km\(^2\), 20 percent of which is located within the country (UN Report 1989). In addition, two of its tributaries, the Kafue and the Luangwa, lie entirely within the country. The country also is bursting with four large lakes, Bangweulu, Mweru, Tanganyika, and Kariba (UN Report 1989). Other water bodies include flood plains and wetlands.
There are three major river systems within the Zambezi River basin and two within the Congo River basins. (Figure 3.2) shows the river drainage systems:

(i) The upper main Zambezi River system is joined by the Luangwa and Kafue tributaries. The upper Zambezi originates in Angola and flows to Mozambique after forming the borders with Botswana, Namibia and Zimbabwe.

(ii) The Kafue River system covers an area of 152,000 km$^2$. The river has two important dams, the Itezhi-Tezhi dam and the Kafue Gorge dam, the latter of which is used for hydropower generation.

(iii) The Luangwa River has a catchment area of 165,000 km$^2$. It drains most of the central parts of the country and empties into the Zambezi.

(iv) The Chambeshi River and the Luapula River are associated with lakes Mweru and Mweru-Wantipa and drain their water into the Congo River system.

(v) The small Tanganyika drainage system is also part of the large Congo River system.
3.4.2 Groundwater

Groundwater is a major source of water in many parts of Zambia. It sustains river flows particularly during the dry season for perennial rivers and streams and can contribute to between 30 and over 90 percent of the total flows (Nymbe and Feilberg, 2009).

The availability of water resources in Zambia has previously been discussed by the Japanese International Cooperation Agency (1992). The findings have been that the country has substantial groundwater resources (Chabwela and Mumba 1998).

There has been a steady growing demand on groundwater use in Zambia. It is estimated that 9% of water usage is from groundwater which provides 28% of domestic water supply (British Geological Survey 2001). The rocks of the Katanga systems...
possess the highest groundwater potential as a single geological sequence that occupies the Northern and Central parts of the country (UN Report 1989). Yields in these systems are highest in the top 30 m or so of the sediment strata where fissures are best developed. These aquifers provide a significant proportion of the water supply for the municipalities of Lusaka, Kabwe, and Ndola where boreholes yield up to 35–50 l/s in karstic sections of the aquifers (UN Report 1989).

### 3.5 Water Supply in Zambia

There are several government ministries and agencies, which are involved in water resources development, management and administration. The Water Development Board and the Department of Water Affairs in the Ministry of Energy and Water Development are the major organizations involved in water resources development while the Resource Conservation is carried out by the two agencies; (1) the Ministry of Environment and Natural Resources and (2) the Environmental Council of Zambia.

The Ministry of Local government and Housing is responsible for providing water supply and sanitation. The National Water Supply and Sanitation council is the regulator of the water supply and sanitation sector. The resource conservation function is carried out by the Ministry of Environment and Natural Resources and the Environmental Council of Zambia. The Ministry of Local government and Housing is responsible for providing water supply and sanitation. The National Water Supply and Sanitation council is the regulator of the water supply and sanitation sector (Phiri 2000, 4).

According to the 1990 census, 2.75 million people had piped water services. Of those who had piped water, 0.97 million people had their households connected to the local provider’s water system. Interestingly, 1.37 million people got their water from
communal taps, which were, located more than 100m away from their homes (Phiri 2000).

3.6 Level of Access to Safe and Clean Water

Access to safe drinking water is measured by the proportion of population with access to an adequate amount of safe drinking water located within a convenient distance from the user’s dwelling. In urban areas, a distance of not more than 200 meters to fetch 20 liters of safe water per person per day from a home to a public water source may be considered reasonable access (WHO 2006).

In Zambia, the government has set the standard access to a domestic water supply at 500 meters from a water supply point. This standard is way too high up compared with the recommended World Health Organization access standard set at 200 meters from a water point. Efforts to reduce the distance covered to a water point have proven difficult due to irregular land use settlement patterns. For example, people erect building structures in places intended for other uses, such as water points. The resulting situation is that, ideally, a water point, which was intended to serve 200 people, ends up serving 900 people. These factors have led to the rate of access to clean and safe water supply to remain low particularly in peri-urban areas where 50 –70 percent of the urban population lives (Ministry of Energy and Water Development 2008).

3.7 National Water Regulations

The aim of a national drinking-water laws and standards are to ensure that the consumer is availed and enjoyed safe and clean drinking water. Effective delivery and
control of drinking water quality should be supported by adequate legislation, standards and codes and their enforcement (WHO 2006).

The precise nature of the water legislation in Zambia depends on the national, constitutional and other considerations. It generally outlines the responsibility and authority of key players and describes the relationship between them as well as establishing basic policy principles, such as water supplied for drinking should be clean and safe to the user. It should also make provision for the establishment and amendment of drinking water quality standards and guidelines, as well as for the establishment of regulations for the development and protection of safe and clean water sources (WHO, 2006). Legislation should also establish the legal functions and responsibilities of the water supplier and should generally specify that the water supplier is legally responsible at all times for the quality of the water supplied to the consumer (WHO 2006).

In November 1994, the Government of Zambia adopted the National Water Policy. The main aim of the policy is to provide a holistic management approach to the water sector. For the water supply and sanitation sector, the policies and strategies are aimed at improving the quality of life and productivity of all people by ensuring an equitable provision of an adequate quantity and quality of water to all competing user and sanitation services to all, at an acceptable cost, and on a sustainable basis. The overall objective of the water policy is to promote sustainable water resources development with a view of facilitating an equitable provision of an adequate quantity and quality of water for all competing users at acceptable cost and ensuring security of supply under varying conditions (National Water Law 1994).
The major legal enactments relating to water in Zambia are as follows:

(a) The Water Act of 1948 is the supreme law on water resource issues in Zambia. It stipulates the ownership of water and the procedures of authorization and invalidation of water use (Phiri 2000, 2).

(b) The Water Supply and Sanitation Act of 1997 was enacted to deal with problems in delivery, protection, conservation, development and management of the water resources. The key to addressing most of these issues had to do with the legal, institutional and organizational framework of the water sector and necessitated the adoption of the National Water Policy of 1994 (National Water Law, Government of Zambia 1994).

In this section, the emerging consensus on water policy was discussed and the major institutions created by parliament to deal with water issues in Zambia.

The following key strategies were enshrined within this policy:

(i) Recognizing the important role of the water sector in the overall socio-economic development of the country

(ii) Vesting control of water resources in the country under state control

(iii) Promoting water resources development through an integrated management approach

(iv) Providing adequate, safe and cost effective water supply and sanitation services with due regard to environmental protection

(v) Defining clear institutional responsibilities of all stakeholders in the Water Sector for effective management and co-ordination

(vi) Recognizing water as an economic good

The 1994 Water Policy is guided by seven key principles, and they are:

(i) Separation of water resources management from supply and sanitation;
(ii) Separation of regulatory and executive functions;

(iii) Devolution of authority (from central government) to local authority and private enterprises;

(iv) Achievement of full cost recovery for the water supply and sanitation services through user charges in the long run;

(v) Human resources development leading to more effective institutions;

(vi) The use of technologies more appropriate to local conditions;

(vii) Increased government priority and budget spending to the sector.

Following the water supply and sanitation sub-sector reforms at different levels, the Government of Zambia launched the Water Resources sub-sector reforms with the Water Resource Action Program in 2001. A Water Resources Management Bill, proposed a new Water Resources Institutional Framework (legal and institutional paper), which was an improved Water Resources Management Information System and a Draft Water Action Plan on how to deal with water resource issues. An additional weight to this process was the target of developing Integrated Water Resources Management Plans as declared at the 2005 Johannesburg World Summit for Sustainable Development. Further, the 2004 Commission on Sustainable Development focused on the water and sanitation sector to toward realizing these goals. As a show of commitment to water development, the Fifth National Development Plan and the Integrated Water Resources Management/Water Efficiency Implementation Plan were to be implemented nationwide.

3.8 Summary

As it has been earlier pointed out, Zambia is bursting with abundant water resources. The problem lies in priorities on the side of policy and decision makers. For
instance, there are many organs of the state involved in water resources, and this has led
to problems of coordination. Also the government is not investing adequate financial
resources in the water sector. The laws that govern water resources lack the realization
component, that is, there is no following through to the demands of the laws and
regulations.
4 CHAPTER FOUR - RESEARCH DESIGN AND APPLICATION OF THE SURVEY

4.1 Introduction

The research design shows how the study was conducted. The key issues addressed include: method, study participants and how they were selected, research design, the procedures, sampling, data collection, and processing and analysis.

4.2 Theoretical Approach

A theory presents a systematic way of understanding events or situations. It is a set of concepts, definitions, and propositions that explain or predict these events or situations by illustrating the relationships between variables (National Cancer Institute 2005).

The theoretical approach used in this study is the Health Belief Model (HBM). This theory was used to describe and analyze the link between the problem of attaining clean and safe water and waterborne diseases. The HBM (Figure 4.1) is a conceptual formulation for understanding why individuals did or did not engage in a wide variety of health related actions. It espouses that behavior depends mainly upon two premises: (1) the value placed by an individual or community on a particular goal, and (2) the estimate of the likelihood that a given action will achieve that goal (Janz and Becker 1984).

In the HBM, behavior change is determined by the way one perceives susceptibility to a disease condition, and severity. This perception is informed and shaped by among other factors, the environment, age and a person’s knowledge of the disease. The prediction of this model is the likelihood of the individual concerned to undertake recommended preventive health actions. The desire to avoid illness (or if ill,
to get well) is shown by the specific action an individual takes to prevent it. Cues to preventive actions are developed based on an individual’s experiencing or seeing another person suffer or die from the disease. These experiences are expected to lead to such preventive behavioral changes as boiling or chlorinating the water before use.

HBM constructs have been used in studies focusing on dealing with cancer control programs (National Cancer Institute 2005). These studies have examined behavior change derived from the way a disease or condition is perceived and the ability to cope.

![Health Belief Model](Source: National Cancer Institute 2005)

**Figure 4-1 Health Belief Model (Source: National Cancer Institute 2005)**

### 4.3 Research Design

Exploratory research design was chosen for purposes of this study because it was found to be suitable for two reasons (1) it is usually a small-scale research undertaken to define the nature of the problem and to gain an understanding of the environment within
which it occurred (McDaniel and Gates 1995); (2) exploratory research is suitable for this study owing to its concern on finding out about what was happening and discovering new insights about a problem.

The study utilized in-depth search of the literature, and collection of data using a questionnaire. It is out of these different sources of information that the details about the nature of the problem are derived (Mancosa 2000).

4.4 Methodology

This section contains a description of the physical steps taken to gather the data. It describes study participants and the procedures such as the administration of the survey. It also describes the instrument used to collect data.

4.5 Study Design

This was a cross-sectional population survey that was conducted in 400 households sampled in Chawama Township, Lusaka, Zambia using the cluster sampling methodology.

4.6 Study Site

For purposes of this study, one typical peri-urban township of Chawama, in Lusaka, was chosen to collect investigative data that sought to understand the problem of attaining safe and clean water and residents’ health with respect to high incidence of waterborne diseases. Figure 4.2 shows the location of Chawama Township in Lusaka.

In this part of the study, an overview of Lusaka City, and then of Chawama Township is discussed.
4.7 Lusaka Overview

Lusaka is the capital city of Zambia situated on the central African plateau at about 1300m above sea level (Figure 4.2). It had an estimated population of 2.2 million inhabitants in 2010 (Central Statistics Office 2011) and is growing mainly due to migration from the rest of the country, but also because of high internal population growth. The city was designed during the colonial era for a population of 500,000 in an area of only 2.6 km$^2$; today it comprises 375 km$^2$. As for city planning, the last approved master plan came into force in 1978. Illegal site developments and quarrying are common in the city (Lusaka City Council Report 2008).

Approximately 1.23 million residents of Lusaka live in low-income unplanned peri-urban areas, a majority of which are slum-like in character. The water supply service in the peri-urban areas of Lusaka is rudimentary, and sanitation service provision by Lusaka City Council to those areas is almost non-existent (Mayumbelo and Münch 2008).

The city has an average annual rainfall of 865 mm and the runoff drains into several different watersheds: the Ngwerere and Chalimbana streams drain most of the northeast of the city into the Chongwe River. Areas in the south and the northwest of the city are drained by the Chunga stream into the Kafue River (Lusaka City Council Report 2008). The few perennial streams in the region are characterized by low flow especially during the dry months of the year (Mpamba et al. 2008).
4.7.1 Lusaka Groundwater

The Lusaka dolomite holds an integrated system of conduits, caves and subterranean channels and therefore constitutes the city’s major aquifer, from which substantial volumes of groundwater is drawn. The trend of groundwater flow in the channels is southeast to northwest (Mpamba et al. 2008).

The water table is in some places situated at extremely shallow depths, ranging from 0.5 to 30 meters below the surface, but it is more typically at six to 15 meters. It has been observed to decline in some places, raising fears of over-exploitation (De Waele and
Roberto 2003). Observations from some boreholes indicate a long-term decreasing trend that risks leaving shallow wells dry during the dry season (Japanese International Cooperation Agency 2009), but that the water table is mainly decreasing in the formal residential areas where boreholes are drilled in schist and quartzite rock.

4.7.2 Lusaka Water Demand

Local water demand is estimated to be 450,000 m$^3$/day considering a daily consumption per person of 180 liters the domestic water demand is estimated in 360,000 m$^3$/day while the remaining 90,000 m$^3$/day are used by industry. 100,000 m$^3$/day of water is taken from the Kafue River, about 40 km south of Lusaka and is brought to the capital through a mostly external pipeline of 2 m diameter. At least 350,000 m$^3$/day is taken from the aquifer, of which 90,000 m$^3$/day comes from 40 production wells of Lusaka city, leaving not less than 260,000 m$^3$/day pumped from 3000-4000 private boreholes (Nyambe and Maseka 2000).

4.7.3 Chawama Township

Chawama Township is bordered by John Laing Township to the west, Misisi Township to the north, and John Howard to the south, and Kamwala Township to the east (See Figure 4.2). It is one of the largest shanty compounds located 8 kilometers south of the Lusaka central business district. It has total population of 97,000 people, and 40,908 households (Central Statistics Office 2011).

Chawama Township was selected for this study because it is one of the peri-urban areas in Lusaka with diverse population, and is close to the central district (Table 4.1) shows some of its characteristics:
Table 4-1  Key characteristics of Chawama Township peri-urban area

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical number of households per plot</td>
<td>3 people</td>
</tr>
<tr>
<td>Approx. population density in people per hectare</td>
<td>244</td>
</tr>
<tr>
<td>Legal status</td>
<td>Recognized by municipality</td>
</tr>
<tr>
<td>Frequency of outbreaks of water-borne diseases (dysentery or other diarrhea)</td>
<td>Endemic</td>
</tr>
<tr>
<td>Expenditure on water as % of household income</td>
<td>0.7 to 5%</td>
</tr>
<tr>
<td>Ownership of toilet</td>
<td>Usage of toilet is commonly shared by all tenants on the plot (average of 12 people) but officially the landlord owns the toilet structure</td>
</tr>
<tr>
<td>Main drinking water Sources</td>
<td>Drilled boreholes within Chawama, And supply from Lusaka Water And Sewerage Company</td>
</tr>
<tr>
<td>Alternative drinking water Sources</td>
<td>Shallow hand-dug wells</td>
</tr>
</tbody>
</table>

(Source: GKW 2005)

Chawama Township started out as a farming area and later was leased to companies for quarrying in the 1940s. Quarrying activities ceased in 1961. The community was incorporated in the city of Lusaka in 1970. From 1974 to 1978 former quarry workers were leased plots to build houses. The government introduced public services in the area in the late 1970s. It is one of the first large-scale squatter upgrading projects that was undertaken by the government between 1975 and 1982 (Fallavier, Mulenga, and Jere 2005).

The dwellings in Chawama Township are predominantly made of concrete block walls with corrugated iron or asbestos sheet roofs, and a large number of them have
backyard space, which is often used to dig water wells. The area is prone to flooding during the rainy season, and is densely populated and lack well-functioning primary services such as water and electricity supply, sewerage systems and solid waste collection.

Shallow wells, hand-dug from the soil and in caves, are common in Chawama township area of Lusaka, and the water is hand-drawn from the vast majority of them. Many of the wells are of the open type, lacking brick or stone wall on the sides, whereas others have a lining and a covered construction.

The lack of a proper sewerage system in this township means that the majority of the population has to make their own sanitation facilities. The on-site pit latrines are commonly used, which are normally simple constructions, four to six meters deep. Dried-up shallow wells are also often converted into pit latrines during the dry season (Mayumbelo and Münch 2008).

The non-raised pit latrines in particular tend to get flooded during the rainy season and high concentrations of pathogens infiltrate the aquifers, contaminating the groundwater. Moreover, most of the latrines are unlined, thus constructed without waterproofing. Although this is not a criterion for considering the latrine ‘improved’, the result is that any liquid from the excreta can rapidly find its way underground (Mayumbelo and Münch 2007). Since the latrines are typically situated close to wells, this contributes to frequent outbreaks of cholera, dysentery and other water-borne diseases, at least during the rainy season (Figure 4.3)
4.7.4 Excretal Disposal

Disposal of fecal matter in Chawama Township is mainly through pit latrines with minor systems of open defecation; pour flush latrines and limited use of flushing toilets or septic tanks. Some of the households do not have their own toilet facilities. Those who have toilet facilities share with other households.

Two types of pit latrines are found in Chawama Township, namely “ground-level and raised” latrines. The ground-level pit latrines are often constructed in sinkholes over which residents build some form of structure made of sacks, plastics, grass or any other available materials (Figure 4.4a). These pit latrines are not built for structural strength, but only for privacy. The raised pit latrines (Figure 4.4b) are usually made of blocks, and when they are filled, they are either abandoned or the excreta removed and the pit can be re-used.
Study participants interviewed were 19 years or older. Most participants were between the ages of 21 and 40 (32%) years. They were asked to participate in this study because they were residents of Chawama Township. The sample of 400 participants was drawn from the 97,000 inhabitants of Chawama Township, Lusaka, Zambia. About 70 percent of the participants were females and 30 percent were males. 51 percent of the participants were married while 19% were single. Comparatively, 26.6 percent had grade 9, and 24.6 percent had grade 12 level of education and only 8.5 percent had a university level of education.

Participation in the study required approximately 30 minutes of interview time. They were initially asked questions about the source and storage of their water. Next they were asked about their knowledge and incidence of waterborne diseases. At the end participants were asked to provide personal information about their age, marital status, gender and level of education. The interviews were not video or audio taped.
4.8.1 Research Study Protocol

As part of research compliance with Health and Human Services regulations, and commitment to human participant research protection program, UNL’s Institutional Review Board (IRB) reviews and approves all human participant research conducted by the faculty, students, staff, or other Institutional representatives regardless of where the research is conducted (Human Research Protections Policies and Procedures (HRPP) 2008, 4). To fulfill this requirement, an application to conduct this study was made to the IRB office. This project was approved as an Expedited protocol, category 6 & 7, and permission to begin the research was officially granted under IRB protocol number “NUgrant Project ID: 11767” (Appendix C).

Furthermore, permission to conduct a survey in the study site was sought from Zambia’s Lusaka Water and Sewerage Company. Authorization to proceed with this part of the study was granted through a letter (Appendix D).

4.8.2 Informed Consent Procedures

The participants were verbally asked if they were willing to participate in the study. A written consent form was also available with the interviewer in cases where it was required. However, in this study area, asking someone to fill out a consent form for purposes of research raised more questions than not doing it at all. Therefore, a verbal agreement was sufficient to give the interviewer the mandate to proceed with the administration of the questionnaire.

4.8.3 Risks and/or Discomforts

There were no known risks or discomforts associated with this research.
4.8.4 Confidentiality

At the start of an interview, participants were assured of confidentiality. They were asked not to give their names, house numbers, or any information that would identify them. They were also informed that any information obtained during this study, which could identify them, would only be accessed by the principal researcher.

Participants were also informed that information obtained in this study was not going to be published in any Scientific Journals or presented at any Scientific Meeting in line with a condition given by the Lusaka Water and Sewerage Company for authorizing the study to be conducted in Chawama Township. LWSC is the main Utility Commercial Company that provides piped water to the residents of Chawama Township. Nongovernmental agencies do provide well water to the residents. For example, the Japanese International Co-operation Agency provides water supply service delivery through community-based schemes to Peri-urban areas (United States Agency for International Development 2006).

In many situations, residents themselves dig shall wells to provide for their supply of water. It was also communicated to the participants that the project personnel had signed a confidentiality agreement to protect their privacy as study research participants. They were also informed that there was no financial compensation for participating in this research study.

4.8.5 Freedom to Withdraw

It was explained to the participants that participation in this study was voluntary and could therefore refuse to participate or withdraw at any time without harming their
4.8.6 Questionnaire

The questionnaire consisted of 20 items some of which had sub-items (Appendix A). The contents of the questionnaire used for this study was based on the household questionnaire model developed by the Zambia Demographic and Health Survey (2003). In consultation with Central Statistical Office, and the study advisor, the original contents of the questionnaire were modified to produce the draft that reflected relevant issues to this study.

The questionnaire consisted of items to which participants were to respond by placing an X in the appropriated boxes. Some basic information was collected on the characteristics of the participants who agreed to feel out the questionnaire, including gender, age, and level of education, marital status, and number of people in the household from participants 19 years and older. The questionnaire collected information on characteristics of the household’s dwelling unit, such as the source of water, and type of toilet facilities. It also collected information on knowledge and experiences of waterborne diseases.

4.9 Study Phase 1

This was a pilot phase when a proposed questionnaire was administered to 20 participants in the study area. This was intended to test the procedures for selection of the sample and an application of the statistical procedures to be used in the data analysis.
stage (Monette, Sullivan and Dejong 2005). This pilot phase provided additional insights into the formulation of the final questionnaire.

A draft version of the questionnaire was prepared and distributed to participants to complete. Informed consent procedures and confidentiality were followed as required by the University of Nebraska-Lincoln research protocol. Based on the nature of the study, requirements by the Zambia Ethics Review Committee were waived. The questionnaire was administered to every 10th household in the housing unit rows. The designation, "every 10th house" was not based on specific numerical labels, for example house No B378; but instead we counted every tenth house from the last person that agreed to participate. This was the convenient method because of the way the housing units are arranged. Completed copies of the proposed draft questionnaires were sent back to the University of Nebraska in the United States for analysis.

This phase was intended to test for clarity and understandability of the questionnaire by the participants. The data collected from the participants were analyzed, and used to guide the design of the final questionnaire on the problem of attaining safe and clean water and experience of high incidence of waterborne diseases.

A discussion to examine the items (questions) in the questionnaire was held with my study advisor, Professor Kuzelka. This discussion focused on the clarity of the questions and their applicability to the Zambian situation. Based on this discussion, the draft questionnaire was further revised to take into consideration some issues raised. The questions on the problem of attaining safe and clean water and experience of high incidence of waterborne diseases were mostly derived from the Questionnaire developed by the Zambia Demographic and Health Survey 2001-2002 (Appendix B).
4.10 Study Phase 2

4.10.1 Research Sample

A sample of 400 participants was drawn from the 97,000 residents of Chawama Township, Lusaka, Zambia. Of the 400 questionnaires collected, 391 were complete and nine were discarded for incomplete responses. This sample was considered appropriate for this study on two grounds (1) to measure changes in selected variables, and (2) to provide a representative sample size large enough to permit detailed analysis.

4.10.2 Method of Sampling Design

Non-probability sampling design was chosen to select participants for this study. Often, units for this type of sample are selected on the basis of known characteristics that seem to represent the population, with the assumption that the units selected will represent the population on unknown characteristics as well (O’Sullivan, Rassel and Berner 2008). This design was chosen for this study because there was not a well-defined sampling frame (O’Sullivan, Rassel and Berner 2008, 135). This sampling technique was applied by administering questionnaires to the participants representing heads of households within the study area.

4.10.3 Recruitment Procedures and Benefits

Participants were approached by interviewers who introduced themselves as research project personnel collecting data on clean and safe water and incidence of waterborne diseases in Chawama. If a participant agreed to participate, then he or she was interviewed and asked to fill out the questionnaire.
The benefits of the study to the participants was (1) gaining a deeper understanding of the problem of attaining safe and clean water and high incidence of waterborne diseases (2) improvement of safe water supply quality through the recommendations that were made to policy and decision makers and cooperating partners.

4.10.4 Administration of the Questionnaire

A total of four field personnel were recruited and trained as interviewers. These administered the questionnaires door to door and carried out face-to-face interviews. The interviewers were trained on interviewing skills including, but not limited to self-introduction, explanation of the purpose of their visit, and the study. They were made to understand every detail of the survey to enable them explain it to the participants who may have difficulties in answering questions.

One of the field interviewers was the contact person and was also responsible to make all necessary arrangements such as the appropriate times to get to the households. A questionnaire was administered to every 10th household in the block. The questionnaires were completed by the household in a single contact. The households were assured that no information about their participation would be revealed to other respondents or to anyone outside of the trained study personnel. In the event a participant experiences a discomfort from participation in this study a local contact person was available to offer further assistance.
4.10.5 Interviewer Training

The training and fieldwork was conducted and completed in September 2011. Four interviewers were trained in interviewing techniques and the contents of the questionnaire. The training included group presentations and mock interviews. In addition, the group instruction training included practice interviews using one common local language.

One field supervisor was present to monitor interviewers and met with them at the end of each workday and reviewed the day’s work.

4.10.6 Variables in the Study

This part attempts to relate the variables to the specific questions and how the items on the questionnaire were used. Table 4.2 shows this information.
<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Research Question</th>
<th>Item on Questionnaire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main source of drinking water</td>
<td>What was the main source of water for participants during the study period? Question #1</td>
<td>See Questions 1 A, B, C, and D: Piped communal, Open well, covered well, Surface water</td>
</tr>
<tr>
<td>Water storage and treatment</td>
<td>How did participants treat and store their water before use? Question #2</td>
<td>See Questions 3, 4 and 6: Closed, open container, add chlorine, boiling</td>
</tr>
<tr>
<td>Type of toilet facilities and sharing.</td>
<td>What type of toilet facilities existed in Chawama Township during the study period, and were they shared with neighbors? Question #3</td>
<td>See Questions 11, and 12 Flush toilet, Traditional pit, VIP latrine, No toilet</td>
</tr>
<tr>
<td>Knowledge of diseases</td>
<td>Did the participants have knowledge of any or all of the water diseases listed on the questionnaire (dysentery, diarrhea, cholera, and typhoid fever? Questions #4</td>
<td>See Questions 13 A, B, C, and D: dysentery, typhoid, cholera, and diarrhea.</td>
</tr>
<tr>
<td>Experience and suffering from waterborne diseases</td>
<td>Did any of the study participants or household member, or neighbor suffer from any of the waterborne diseases listed on the questionnaire? Question #5</td>
<td>See Questions 14A,B, C, F. Responses: Yes, No.</td>
</tr>
</tbody>
</table>

4.10.7 Data Processing and Analysis

The data processing of the questionnaire results began following the completion of the fieldwork. Completed questionnaires were returned from Zambia to the United States where they were entered and analyzed using the PASW Statistics 18.0 (1993-2008) software. For the analysis of the data, independent variables used in the analysis include gender, age, level of education, source of drinking water, and knowledge of waterborne diseases. In the data analysis process, descriptive statistics was used to describe the sample. Descriptive statistics included cross tabulations and frequency table that showed the percentages of variables derived from the questionnaire. Cross tabulation tables were used to analyze the differences between variables of interest.
4.11 Summary

This chapter provided a description of the steps involved in carrying out this research study. The informed consent procedures and steps taken to maintain confidentiality were described. The study sample and the administration of the questionnaire used to collect data were also highlighted. Variables, research questions, and items on a Questionnaire including method of sampling were discussed. Recruitment procedure and data processing and analysis were fully described.
5 CHAPTER FIVE - SURVEY RESULTS

5.1 Introduction

This study sought to answer the five research questions (Refer to Table 4.2). It also provides a descriptive summary of some of the demographic characteristics of the population such as gender, marital status, age and level of education. The questionnaire was used to collect information from the participants. This information was essential for the interpretation of the study questionnaire results.

5.2 Demographic Characteristics

Demographic variables are the primary basis of classification in vital statistics and surveys (Zambia Demographic and Health Survey 2003). A total of 400 questionnaires were collected from the study participants. During the data cleaning process, 9 questionnaires were discarded for incompleteness and uncoordinated responses. Consequently, a total of 391 questionnaires were admitted for analysis.

5.2.1 Age and Gender of participants (Questions 15 and 16, Section C)

The demographic characteristics of the sample (N=391) are shown in Table 5.1. The data shows that there were more females than males who participated in the survey. There were 271 females (69.3 percent), and 120 males (30.7 percent) giving a total of 391 participants. The number of participants 31 to 40 years (n=124) was higher than those reported for other age groups while the number of the participants 60 years and over (n=40) was the lowest.
### Table 5-1 Percentages of females and males in various age groups

<table>
<thead>
<tr>
<th>Gender</th>
<th>19 years</th>
<th>20-30 years</th>
<th>31-40 years</th>
<th>41-50 years</th>
<th>60 years and over</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>33.3%</td>
<td>33.0%</td>
<td>24.2%</td>
<td>31.8%</td>
<td>60.0%</td>
<td>30.7%</td>
</tr>
<tr>
<td></td>
<td>(n =15)</td>
<td>(n = 31)</td>
<td>(n = 30)</td>
<td>(n = 28)</td>
<td>(n = 24)</td>
<td>(n = 120)</td>
</tr>
<tr>
<td>Female</td>
<td>66.7%</td>
<td>67.0%</td>
<td>75.8%</td>
<td>68.2%</td>
<td>40.0%</td>
<td>69.3%</td>
</tr>
<tr>
<td></td>
<td>(n = 30)</td>
<td>(n = 63)</td>
<td>(n = 94)</td>
<td>(n = 60)</td>
<td>(n = 16)</td>
<td>(n = 271)</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>(n=45)</td>
<td>(n=94)</td>
<td>(n=124)</td>
<td>(n=88)</td>
<td>(n=40)</td>
<td>(n=391)</td>
</tr>
</tbody>
</table>

### 5.2.2 Participants Levels of Education (Question 18, Section C)

In this study, information on education attainment was collected for the participant who filled out the questionnaire. The results are presented in Table 5.2. The collected data shows that the number of participants who had attained grade 9 level of education was high (n=109). The results also show that the rate of females was high in all of the levels of education 69.3 percent (n=271) compared to 30.7 percent (n=120) of their male counterparts. The number of participants with a university level of education was the lowest (n=31).
Table 5-2 Percentages of level of education of males and females participants

<table>
<thead>
<tr>
<th>Gender</th>
<th>Grade 7</th>
<th>Grade 9</th>
<th>Grade 12</th>
<th>Institute</th>
<th>College</th>
<th>University</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>23.8%</td>
<td>22.9%</td>
<td>31.1%</td>
<td>43.6%</td>
<td>34.8%</td>
<td>48.4%</td>
<td>30.7%</td>
</tr>
<tr>
<td></td>
<td>(n =15)</td>
<td>(n =25)</td>
<td>(n =32)</td>
<td>(n =17)</td>
<td>(n =16)</td>
<td>(n =15)</td>
<td>(n =120)</td>
</tr>
<tr>
<td>Female</td>
<td>76.2%</td>
<td>77.1%</td>
<td>68.9%</td>
<td>56.4%</td>
<td>65.2%</td>
<td>51.6%</td>
<td>69.3%</td>
</tr>
<tr>
<td></td>
<td>(n =48)</td>
<td>(n =84)</td>
<td>(n =71)</td>
<td>(n =22)</td>
<td>(n =30)</td>
<td>(n =16)</td>
<td>(n =271)</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>(n =63)</td>
<td>(n =109)</td>
<td>(n =103)</td>
<td>(n =39)</td>
<td>(n =46)</td>
<td>(n =31)</td>
<td>(n =391)</td>
</tr>
</tbody>
</table>

5.2.3 Participants Marital Status (Question 17, Section C)

Marital status is an important aspect of the value system upon which individuals, married, single, separated, or widowed are revered. Marital status is deemed to be the pillar of family life and a driver of societal values. Care for the sick, and ability to tackle community problems are all viewed in the context of the marital status of an individual. In Zambia, the married and the widowed are held in higher esteem than the separated and the single. The results of the marital status responses are presented in Table 5.3.

The results show that the majority of the participants were married (48.6 percent). This shows that the family system is still strong and intact. Notably though, the percentage of the widowed was relatively high (15.1 percent).
Table 5-3 Percentages of marital status

<table>
<thead>
<tr>
<th>Count</th>
<th>Married</th>
<th>Divorced</th>
<th>Separated</th>
<th>Widow/widower</th>
<th>Single</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentages</td>
<td>48.6%</td>
<td>10.0%</td>
<td>7.9%</td>
<td>15.1%</td>
<td>18.4%</td>
<td>100%</td>
</tr>
<tr>
<td>Numbers</td>
<td>(n=190)</td>
<td>(n=39)</td>
<td>(n=31)</td>
<td>(n=59)</td>
<td>(n=72)</td>
<td>(391)</td>
</tr>
</tbody>
</table>
5.2.4 Participants Water Source and Preventive Measures

The most common sources of water for the Zambian households are open wells, protected wells, communal taps, rivers and streams. In urban areas, most drinking water comes from piped sources and wells (Zambia Demographic and Housing Survey 2003). Water quality has a strong impact on the health of household members, particularly young children. A source of water is important because potentially waterborne diseases, such as typhoid fever, cholera, and dysentery, are prevalent in unprotected sources. Water supply sources expected to be relatively free of these diseases are piped water and water drawn from protected wells and deep boreholes. Other sources, such as communal tap, unprotected and shall wells, and surface water (rivers, ponds and lakes) is more likely to carry disease-causing agents (Zambia Demographic and Housing Survey 2003).

The first research question concerned the main source of water for participants during the study period. They were asked to identify their source of drinking water. The results (Table 5.4) show that the most common source of water for the study participants was communal city taps 61.4 percent (n=232). Slightly half, 29.6 percent (113) got their water from piped city water. The remainder got their water from various other sources.
### Participants Main Source of Drinking Water

<table>
<thead>
<tr>
<th>Piped city water</th>
<th>Communal city tap</th>
<th>Open well in yard</th>
<th>Protected well in yard</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage</td>
<td>29.6%</td>
<td>61.4%</td>
<td>3.3%</td>
<td>5.4%</td>
</tr>
<tr>
<td>Number</td>
<td>(112)</td>
<td>(232)</td>
<td>(13)</td>
<td>(21)</td>
</tr>
</tbody>
</table>

*missing 3.35% (n=13)

#### 5.2.5 Water Treatment and Storage before Use

The second question asked participants how they treated their water; and how they stored it to make it safe for use. Residents in the study area store their water in open or closed containers. This is done because there is not enough water to run throughout the day, or it has to be fetched from a communal tap which may be situated a long distance away from the residential house.

Participants were asked whether they boiled their water before using it as a precaution to making it safe for use (Research Question #2). The results (Table 5.5) show that 62.2 percent (n=130) of those who got water from the communal city tap did not boil it while 64.8 percent (n=94) from the same water source (communal tap) indicated that they boiled their water some of the time. Of those using piped water, only 35.4 percent (n=74) did not boil their water.
Table 5-5 Percentages of various sources of water by boiling it before use

<table>
<thead>
<tr>
<th>Boiling Water</th>
<th>Main source of drinking Water</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Piped city water</td>
<td>Communal city tap</td>
<td>Open well in yard</td>
<td>Protected yard well</td>
<td>Total</td>
</tr>
<tr>
<td>No</td>
<td>35.4% (n =74)</td>
<td>62.2% (n =130)</td>
<td>1.0% (n =2)</td>
<td>1.4% (n=3)</td>
<td>100%</td>
</tr>
<tr>
<td>Yes, some of the time</td>
<td>24.1% (n =35)</td>
<td>64.8% (n =94)</td>
<td>4.8% (n =7)</td>
<td>6.2% (n =9)</td>
<td>100%</td>
</tr>
<tr>
<td>Yes, most of the time</td>
<td>10.8% (n =4)</td>
<td>54.1% (n =20)</td>
<td>10.8% (n =4)</td>
<td>24.3% (n =9)</td>
<td>100%</td>
</tr>
</tbody>
</table>

5.2.6 Source of water and Chlorine use

Chlorine is used to purify water by adding measured drops or powder sachets in a container of water. Participants were asked whether they added chlorine to their water before using it (Research Question #2). The results are shown in Figure 5.6. The results show that a fairly larger number of participants (n=202) who got their water from various sources did not add chlorine to it. Of those who drew water from communal sources, 66.8 percent (n=135) did not add chlorine.
Table 5-6 Percentages of main water source by participant chlorine use

<table>
<thead>
<tr>
<th>Adding Chlorine</th>
<th>Piped city water</th>
<th>Communal city tap</th>
<th>Open well in yard</th>
<th>Protected well in yard</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>25.2% (n=51)</td>
<td>66.8% (n=135)</td>
<td>3.0% (n=6)</td>
<td>5.0% (n=10)</td>
<td>100%</td>
</tr>
<tr>
<td>Yes, some of the time</td>
<td>32.8% (n=62)</td>
<td>57.7% (n=109)</td>
<td>3.7% (n=7)</td>
<td>5.8% (n=11)</td>
<td>100%</td>
</tr>
</tbody>
</table>

5.2.7 Source of Water and Storage

Participants were asked to indicate how they stored their water before they used it (Research Question #2). Table 5.7 shows that a high number of participants (n=222) stored their water in closed containers. Of these 61.5 percent (n=104) of those who got water from communal taps stored it in open containers.
Table 5-7 Source Drinking Water by Storage

<table>
<thead>
<tr>
<th>Water Storage</th>
<th>Piped city water</th>
<th>Communal city tap</th>
<th>Open well in yard</th>
<th>Closed well in yard</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed container</td>
<td>32.9% (n=73)</td>
<td>63.0% (n=140)</td>
<td>1.4% (n=3)</td>
<td>2.7% (n=6)</td>
<td>100% (n=222)</td>
</tr>
<tr>
<td>Open container</td>
<td>23.7% (n=40)</td>
<td>61.5% (n=104)</td>
<td>5.9% (n=10)</td>
<td>8.9% (n=15)</td>
<td>100% (n=169)</td>
</tr>
</tbody>
</table>

5.3 Participants Type of Toilet Facilities and Sharing with Neighbors

To address the third question, participants were asked about the type of toilet facilities they had and whether they shared with neighbors. Table 5.8 shows that 36.9 percent of the participants had traditional pit latrines. These findings give support to the problem of water related diseases. Notably, the percentage of participants (17.1%) who did not have toilet facilities was relatively high.

Table 5-8 Participants Type of Toilet Facilities

<table>
<thead>
<tr>
<th>Traditional Pit Latrines</th>
<th>Flush Toilet</th>
<th>Ventilated Improved Latrine</th>
<th>No Toilet Facility</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>36.9% (n=142)</td>
<td>18.4% (n=71)</td>
<td>27.5% (n=106)</td>
<td>17.1% (n=66)</td>
<td>98.5% (n=385)</td>
</tr>
</tbody>
</table>

- Missing 1.5% (n=6)
5.3.1 Sharing of Toilet Facilities

The sharing of toilet facilities with neighbors was explored to find out if it was common. The sharing of such facilities is a potential vehicle for waterborne disease outbreaks. Table 5.9 shows that participants with traditional (74.5%) and those with ventilated improved (63.2%) latrines generously shared their toilets facilities with neighbors. These findings give support to potential spread of waterborne diseases.

<table>
<thead>
<tr>
<th>Sharing Toilet Facility</th>
<th>Traditional Pit Latrine</th>
<th>Flush Toilet</th>
<th>Ventilated Improved Latrine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>74.5%</td>
<td>22.5%</td>
<td>63.2%</td>
</tr>
<tr>
<td>(n=105)</td>
<td>(n=16)</td>
<td></td>
<td>(n=67)</td>
</tr>
<tr>
<td>No</td>
<td>25.5%</td>
<td>77.5%</td>
<td>36.8%</td>
</tr>
<tr>
<td>(n=36)</td>
<td>(n=55)</td>
<td></td>
<td>(n=39)</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

5.4 Participants Knowledge of Waterborne Diseases

The fourth research question concerned the participants’ knowledge of waterborne diseases listed on the questionnaire. Knowledge is important for purposes of diseases prevention and care. Table 5.10 shows that the two well-known waterborne diseases among the participants were cholera and diarrhea with 94.6 percent knowledge rate. More than two thirds of the participants have heard or were aware of these waterborne diseases.
Table 5-10 Distribution of disease knowledge

<table>
<thead>
<tr>
<th>Knowledge/awareness of the diseases</th>
<th>Cholera</th>
<th>Diarrhea</th>
<th>Dysentery</th>
<th>Typhoid Fever</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage</td>
<td>94.6</td>
<td>94.6</td>
<td>67.8</td>
<td>68</td>
</tr>
<tr>
<td>Number</td>
<td>369</td>
<td>367</td>
<td>251</td>
<td>246</td>
</tr>
</tbody>
</table>

5.4.1 Participants’ Experience with Waterborne diseases

The fifth question addressed the question of whether study participants ever heard of any of their neighbor's household member who suffered from dysentery, typhoid, diarrhea or cholera. Experience of the disease meant either a participant heard about a neighbor who suffered or a member of their households or the participants themselves. This was intended to relate their knowledge of the diseases to their real life experiences. Table 5.11 shows that almost 50 percent (47.9%) of the participants indicated that they had knowledge of a neighbor or family member who suffered from a waterborne disease in the past six months prior to the survey. These findings suggest that participants were well aware of the effects of these diseases.
Table 5-11 Percentages of participants knowledge of neighbor experience of waterborne diseases

<table>
<thead>
<tr>
<th>Hearing of neighbor suffer from waterborne diseases</th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage</td>
<td>47.9</td>
<td>52.1</td>
<td>100</td>
</tr>
<tr>
<td>Number</td>
<td>(186)</td>
<td>(202)</td>
<td>388</td>
</tr>
</tbody>
</table>

- Missing .8% (n=3)

5.4.2 Knowledge of experience of household or neighbors who died of the diseases

Participants were asked whether they were aware of a neighbor or household member who had died from a waterborne disease. Of those who participated (Table 5.12) 74 percent denied knowledge of a neighbor dying from a waterborne disease. The remainder (26%) indicated they had heard of someone who had died.

Table 5-12 Percentage of household who died from waterborne Diseases

<table>
<thead>
<tr>
<th>Experience of neighbors who died from waterborne diseases</th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage</td>
<td>26</td>
<td>74</td>
<td>100</td>
</tr>
<tr>
<td>Number</td>
<td>(101)</td>
<td>(288)</td>
<td>(389)</td>
</tr>
</tbody>
</table>

*Missing .5% (n=2)
5.5 Participant knowledge of cholera by Level of Education

Participants’ knowledge of cholera was compared with level of education. It was expected that those with a higher level of education were likely to be more aware of the diseases. Table 5.13 shows that in Chawama Township, the level of education did not matter. Almost every household had knowledge of cholera.

**Table 5-13 Knowledge of Cholera disease by level of Education**

<table>
<thead>
<tr>
<th>Knowledge (Cholera)</th>
<th>Grade 7</th>
<th>Grade 9</th>
<th>Grade 12</th>
<th>Trades</th>
<th>College</th>
<th>University</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>92.1%</td>
<td>94.5%</td>
<td>96.1%</td>
<td>92.3%</td>
<td>100%</td>
<td>90.3%</td>
<td>94.6%</td>
</tr>
<tr>
<td>(n=58)</td>
<td>(n=99)</td>
<td>(n=36)</td>
<td>(n=46)</td>
<td>(n=28)</td>
<td>(n=370)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>7.9%</td>
<td>5.5%</td>
<td>3.9%</td>
<td>7.7%</td>
<td>0%</td>
<td>9.7%</td>
<td>5.4%</td>
</tr>
<tr>
<td>(n=5)</td>
<td>(n=6)</td>
<td>(n=4)</td>
<td>(n=3)</td>
<td>(n=0)</td>
<td>(n=3)</td>
<td>(n=21)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>(n=63)</td>
<td>(n=109)</td>
<td>(n=103)</td>
<td>(n=39)</td>
<td>(n=46)</td>
<td>(n=31)</td>
<td>(n=391)</td>
</tr>
</tbody>
</table>

5.6 Knowledge of Typhoid Fever by Level of Education

Table 5.14 compared participant knowledge of typhoid fever with level of education. The idea was to find out if there was a relationship between knowledge of typhoid and level of education. The results show that level of education did not matter. These findings support the idea that residents had lived with the diseases well enough to attain extra knowledge to know them.
<table>
<thead>
<tr>
<th>Knowledge of Typhoid</th>
<th>Grade 7</th>
<th>Grade 9</th>
<th>Grade 12</th>
<th>Trades</th>
<th>College</th>
<th>University</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>60.3%</td>
<td>75.2%</td>
<td>66.0%</td>
<td>61.5%</td>
<td>73.9%</td>
<td>61.3%</td>
<td>67.8%</td>
</tr>
<tr>
<td></td>
<td>(n=38)</td>
<td>(n=82)</td>
<td>(n=68)</td>
<td>(n=24)</td>
<td>(n=34)</td>
<td>(n=19)</td>
<td>(n=265)</td>
</tr>
<tr>
<td>No</td>
<td>39.7%</td>
<td>24.8%</td>
<td>34.0%</td>
<td>38.5%</td>
<td>26.1%</td>
<td>38.7%</td>
<td>32.2%</td>
</tr>
<tr>
<td></td>
<td>(n=25)</td>
<td>(n=27)</td>
<td>(n=35)</td>
<td>(n=15)</td>
<td>(n=12)</td>
<td>(n=12)</td>
<td>(n=126)</td>
</tr>
<tr>
<td>Total</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td></td>
<td>(n=63)</td>
<td>(n=109)</td>
<td>(n=103)</td>
<td>(n=39)</td>
<td>(n=46)</td>
<td>(n=31)</td>
<td>(n=391)</td>
</tr>
</tbody>
</table>
CHAPTER SIX - DISCUSSION AND RECOMMENDATIONS

6.1 Discussion

Zambia is endowed with plentiful water resources mainly from the rivers, lakes, wetlands, and groundwater. For instance, the basin of the Zambezi River covers around three-quarters of the country. The problem of attaining clean and safe water therefore goes beyond the availability of the liquid water.

The first question of this study was to assess the main source of water for residents of Chawama, Lusaka. In the study sample of 400 participants, it was found that most of the residents got water from a communal tap (61.4%), suggesting that the risk of public health exposure was high. Findings from the study clearly revealed that the residents had an overwhelming knowledge of waterborne diseases (94.6%). The familiar waterborne diseases to them include cholera, diarrhea, dysentery, and typhoid fever. Whereas they had this knowledge, it was noted from the study results that most of the residents did not boil (62.2%) or add chlorine (66.8%) to make the water safe for use. Therefore, this situation suggests that residents of Chawama Township are not doing enough to prevent outbreaks of waterborne diseases. One of the more interesting outcomes was the large number of widowed residents, and this could be attributed to the AIDS epidemic.

The housing arrangements in Chawama township coupled with the area’s prone to flooding during the rainy season, and densely populated neighborhoods characterized by lack of properly functioning sewerage systems and solid waste collection makes it a public health hazard as well as problematic to development of water supply infrastructure.
Education attainment is a key determinant of the lifestyle and status an individual enjoys in a society. It is, for instance, one of the key indicators of the status of women as indicated in an International Labor Organization (ILO) briefing kit (ILO 1995). Furthermore, studies consistently show that educational attainment has a substantial effect on disease prevention measures, attitudes and awareness to hygiene (Zambia Demographic and Health Survey 2003, 15).

Formal education in Zambia is based on a three tier system: primary education consisting of 7 years, junior secondary school consisting of 2 years, and senior secondary school consisting of 3 years. Upon completion of secondary school, an individual may choose to move up the education ladder by either going to the university for 4 to 7 years, depending on the field of study, and obtain a degree, or choose to attend a vocational or technical institute for a two to three-year certificate/diploma course. In this study, although females seem to be more educated than the males, the reality might lie in the fact that female were the majority who participated in the survey, suggesting that men might not have been at home. Furthermore, results show that women play a major role in securing water in the household. This can be explained by the cultural role in which females tend to be in charge of domestic roles more than their male counterparts.

Level of education seems not to have any bearing to the knowledge of waterborne diseases and treatment of water. This finding seems to be inconsistent with education being a key determinant of the lifestyle and status individual enjoy in a society.
6.2 Recommendations

The findings of this study point to some important policy implications. For instance, access to clean and safe drinking water for the majority of urban dwellers requires effort from the community and policy makers. It also suggests paying great attention to water-handling methods by sensitizing households to healthy behaviors particularly in the water collection and storage conditions. Second, as most individuals use water directly from available sources without any form of treatment, and may, therefore, be exposed to various water-related diseases, it seems logical to suggest that current regulations be revised to include water-quality testing.

Public health concerns due to the problem of attaining clean and safe water are influenced by the source, treatment and storage of water, toilet facilities and knowledge of waterborne diseases. Based on this, the following are recommendations for intervention into waterborne diseases among residents of Chawama Township, Lusaka.

1. Although Zambia has made important advances in regulatory and institutional reforms, there must be a continued reviewing and implementation of the national water policies rather than just having them on paper.

2. Health education programs need to focus on empowering women because of their major role in securing clean and safe water for households.

3. The government need to develop policies that encourage cooperating partners to work directly with communities.

4. The government needs to develop and encourage a policy that lets water providers to work directly with residents on how best they can be provided and pay for the water supply.
(5) Although hygiene education programs are being incorporated in water and sanitation programs to raise awareness about waterborne diseases and to promote positive hygienic practice, the government should put more effort in this area particularly during the rainy season.

(6) There is need to have public fee paying toilets at strategic points in Chawama which could at least be open to the public up to 22.00 hours.

6.3 Limitation and Value of the Research Study

6.3.1 Limitation of the Study

This is the first known study that explored the problem of attaining clean and safe water in Chawama Township, Lusaka, Zambia. This makes the findings to be limited in scope. However, it has highlighted potential relationship between attaining safe water and waterborne diseases. Although the questionnaire started with a pilot phase to assess its suitability, the study did not examine cultural considerations that may have hindered or enhanced the research study. Such studies will require a much deeper understanding of certain aspects of the Zambian culture hidden in its 73 languages and how these affect questionnaire responses. For example, sample size did not allow for the exploration of differences in attitudes toward water and diseases as held by individual cultural group.

It is therefore, important to consider some limitations that may affect the generalizability of the results of this study. These limitations point to opportunities for further studies on this topic among peri-urban residents in Zambia.

First, there is need to further develop and refine the questionnaire to be able to adequately assess the problem of attaining safe water and waterborne diseases, attitudes
and situations that could lead to adequate disease prevention behaviors. Second, it would be useful to assess more accurately the involvement of males in handling water problems. Third, this research focused on the problem of attaining safe water and waterborne diseases without paying much attention to factors such as poor or lack of drainage system which lead to flooding. This is a limitation because waterborne diseases can be spread by mediums other than directly ingesting dirty water. For example consuming of unwashed fruits or vegetables can lead to cholera or dysentery infection.

6.3.2 Value of the Research Study

Although the study has limitations, it also has value to the water sector and cooperating partners as follows: (1) a clear understanding of the link between unsafe water and waterborne diseases can help designing disease interventions that can shape attitudes and practices among water users, (2) findings of the study are useful to water providers for purposes of planning, management and evaluation of water supply services, (3) the information from the study is helpful to health systems to monitor trends and respond decisively to curb the problem of water-borne diseases, (4) the study provided opportunities for future studies to fill in the gaps that this study could not address, (5) this study added value to the existing body of knowledge on waterborne diseases and play a vital role in providing people with information on public health, and (6) this study highlighted the problem of attaining safe water, and made recommendation to policy and decision makers on how best the water supply can be improved. These recommendations are applicable to other peri-urban areas that are in a similar situation.
6.4 Future of Research

This research study explored the problem of attaining clean and safe water and incidence of waterborne diseases. The literature in this area is abundantly available. Future research should include other variables that could impact the interaction and interpretation of unsafe water and waterborne diseases. Suggestions for further research include examination of (1) how water and disease interact to cause an illness, (2) in spite of knowing about waterborne diseases, why residents have not taken seriously measures to prevent the diseases, (3) whether redesigning the township would work to solve the water and disease problems?
7 References


Suresh, K., and H. Smith n.d. Tropical organisms in Asia/Africa/South America.


UNICEF. N.d. *Charting the Progress of Populations*


Hello, my name is ________________________ and I am working with Passmore Mudundulu, a student researcher at the University of Nebraska in the USA. We are conducting a survey about drinking water and high incidence of water borne diseases some of which lead to death. We would very much appreciate your participation in this survey, but please understand that your participation is strictly voluntary. You will not be compensated for your participation and will not receive any direct benefits. I would like to ask you about your sources of drinking water, what you know about water borne diseases, if you or any of your family members or neighbors has had any of these diseases and what the effects of those diseases were. I will also ask you some demographic questions. You may feel some emotional distress when answering questions about your family members or neighbors. Please understand that this is not a government-based study. The information from this study will be used to create recommendations for government policy guidelines to plan clean water services. Any individual information you provide in this study will be kept strictly confidential. Your decision whether or not to participate will not affect any benefits to which you are entitled, or any relationship with the researcher or the government or cooperating partners. By completing the survey you are showing consent to participate.

Do not write your name or house number or any identifying information on this questionnaire.

Please indicate your response to the following questions by placing an X in the appropriate box.

Section A. Source of Drinking water

1. What is the main source of drinking water for members of your household?

A. Piped water

☐ Piped water into dwelling (house)

☐ Piped water into yard or plot

☐ Communal tap

B. Water from open well

☐ Open well in yard or plot
Open public well

C. Covered well or borehole

Protected well in yard or plot

Protected public well (City council or NGO provided well)

D. Surface Water

River/stream

Pond/lake/dam

Rainwater

E. Tanker truck

F. Bottled water

G. Other (specify)

2. How long does it take you to go there, get water, and come back?

15 minutes

30 minutes

One hour

More than 1 hour

3. How do you store your drinking water?

Closed container/ “Budiza”

Open container/bucket

Other

4. Do you usually boil your drinking water?

Yes, most of the time

Yes, some of the time

No

5. Have you ever seen or heard of a product called Chlorine—a liquid that can be used to make water safe to drink?

Yes

No

6. Is your household water currently treated with chlorine?

Yes

No
7. Do you care about the source of your household drinking water? Yes □ No □

8. If the city council piped water was supplied to your household, would you be willing to pay for the service? Yes □ No □

9. If you answered yes in number 8, how much would you pay per month for your water bill?

□ K5000 – K15000 □ K15000 – K25000 □ K25000 - K35000 □ K35000 or more

10. If the city council water is currently supplied to your household, how frequently do you receive the supply? □ 2-6 hours daily □ 24 hours daily □ None □ Other ___

11. What kind of toilet facilities does your household have?

□ Flush toilet □ Traditional pit latrine □ Ventilated Improved Pit latrine

□ No toilet facility □ Other ___________________________ (specify)

12. Do you share these toilet facilities with other households? Yes □ No □

Section B. Incidence of water borne diseases

13. Have you ever heard of any of the following diseases?

   A. Dysentery   Yes □ No □
   B. Typhoid     Yes □ No □
   C. Cholera     Yes □ No □
   D. Diarrhea    Yes □ No □

14. If you answered yes to any one of the diseases in number 13 above

   A. Have you ever heard of any of your neighbor’s household member who suffered from dysentery, Typhoid, diarrhea, or cholera? □ Yes □ No
(i) If yes, when did the most recent incident happen?

☐ Last 6 months  ☐ Last 12 months  ☐ Last two years  ☐ Last five years

(ii) What was the age of that person?  ☐ Under 5 years  ☐ Youth  ☐ Adult

B. Has anyone in your neighbor’s household died of dysentery, Typhoid, diarrhea, Cholera?

☐ Yes  ☐ No

C. Has anyone in your household suffered from any of these diseases?  Yes ☐  No ☐

D. If yes, when did the most recent incident happen?  ☐ Last 6 months  ☐ Last 12 months  ☐ Last two years  ☐ Last five years

E. What was the age of the person?  ☐ Under 5 years  ☐ Youth  ☐ Adult

F. Have you yourself, suffered from any one of them?  Yes ☐  No ☐

G. If yes, when did the most recent incident happen?  ☐ Last 6 months  ☐ Last 12 months  ☐ Last two years  ☐ Last five years

H. Has anyone in your household died of dysentery, Typhoid, diarrhea, Cholera?

Yes ☐  No ☐

(i) If yes, when did the most recent incident happen?

☐ Last 6 months  ☐ Last 12 months  ☐ Last two years  ☐ Last five years

(ii) What was the age of the person who died?  ☐ Under 5 years  ☐ Youth  ☐ Adult

Section C. Demographics

15. What is your age?

☐ 15-19 years  ☐ 20-30 years  ☐ 31-40 years  ☐ 41-50 years  ☐ Over 60 years
16. What is your gender?

☐ Male   ☐ Female

17. What is your current marital status?

☐ Married
☐ Divorced
☐ Separated
☐ Widow/Widower
☐ Single

18. What is your education level completed?

☐ Grade 7
☐ Grade 9
☐ Grade 12
☐ Institute/Trades
☐ College
☐ University

19. Please indicate the number of people in your household: _______
# APPENDIX B - Zambia Demographic and Health Survey

## HOUSEHOLD SCHEDULE

Now we would like some information about the people who usually live in your household or who are staying with you now.

<table>
<thead>
<tr>
<th>LINE NO</th>
<th>USUAL RESIDENTS AND VISITORS</th>
<th>RELATIONSHIP TO HEAD OF HOUSEHOLD</th>
<th>SEX</th>
<th>RESIDENCE</th>
<th>AGE</th>
<th>ELIGIBILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>What is the relationship of (NAME) to the head of the household?*</td>
<td>M/F</td>
<td>YES/NO</td>
<td>YES/NO</td>
<td>IN YEARS</td>
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<td>01</td>
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</table>

*CODES FOR Q3

RELATIONSHIP TO HEAD OF HOUSEHOLD:
01 = HEAD
02 = HUSBAND/WIFE
03 = SOI/DAUGHTER
04 = SIBLING
05 = GRANDCHILD
06 = PARENT
07 = PARENT-IN-LAW
08 = BROTHER/SISTER
09 = NEPHEW/NIECE
10 = CO-WIFE
11 = OTHER RELATIVE
12 = ADOPTED/FOSTER
13 = NOT RELATED
65 = DON'T KNOW
<table>
<thead>
<tr>
<th>LINE NO.</th>
<th>PARENTAL SURVIVORSHIP AND RESIDENCE FOR PERSONS LESS THAN 15 YEARS OLD**</th>
<th>EDUCATION</th>
<th>IF AGE 5 YEARS OR OLDER</th>
<th>IF AGE 5-24 YEARS</th>
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<tbody>
<tr>
<td></td>
<td>If Alive</td>
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<tr>
<td></td>
<td>Is (NAME)'s natural mother alive?</td>
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<td>Does (NAME)'s natural mother live in this house-</td>
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<td>hold? If YES: What is her name? RECORD MOTHER'S</td>
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<td>LINE NUMBER</td>
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<td>Is (NAME)'s natural father alive?</td>
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<td>Does (NAME)'s natural father live in this house-</td>
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<td>hold? If YES: What is his name? RECORD FATHER'S</td>
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<td>LINE NUMBER</td>
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<td>If Alive</td>
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<td>Has (NAME) ever attended school?</td>
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<td>What is the highest level of school (NAME) has</td>
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<td>attended?</td>
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<td>What is the highest grade (NAME) completed at</td>
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<td>that level?***</td>
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<td>Is (NAME) currently attending school?</td>
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<td>Did (NAME) attend school in 2001?</td>
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<td>During the current school year/year 2001, did (</td>
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<td></td>
<td>NAME) attend school at any time?</td>
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<td>During the previous school year/year 2000, did (</td>
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<td></td>
<td>NAME) attend school at any time?</td>
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<td>During that school year/year 2000, what level and</td>
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<td></td>
<td>grade did (NAME) attend?***</td>
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<td>YES NO DK</td>
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</table>

** Q.10 THROUGH Q.13
THESE QUESTIONS REFER TO THE BIOLOGICAL PARENTS OF THE CHILD.
IN Q.11 AND Q.13, RECORD "00" IF PARENT NOT LISTED IN HOUSEHOLD SCHEDULE.

***CODES FOR Qs. 15, 18 AND 20
EDUCATION LEVEL:
0 = NURSERY SCHOOL, KINDERGARTEN
1 = PRIMARY
2 = SECONDARY
3 = HIGHER
8 = DON'T KNOW

EDUCATION GRADE:
00 = LESS THAN 1 YEAR COMPLETED
08 = DON'T KNOW
<table>
<thead>
<tr>
<th>LINE NO.</th>
<th>USUAL RESIDENTS AND VISITORS</th>
<th>RELATIONSHIP TO HEAD OF HOUSEHOLD</th>
<th>SEX</th>
<th>RESIDENCE</th>
<th>AGE</th>
<th>ELIGIBILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Please give me the names of the persons who usually live in your household and guests of the household who stayed here last night, starting with the head of the household.</td>
<td>What is the relationship of (NAME) to the head of the household?*</td>
<td>Is (NAME) male or female?</td>
<td>Does (NAME) usually live here?</td>
<td>How old is (NAME)</td>
<td>CIRCLE LINE NUMBER OF ALL WOMEN AGE 15-49</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>M</td>
<td>F</td>
<td>YES</td>
<td>NO</td>
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<td>12</td>
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<td>M</td>
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</table>

* CODES FOR Q.3
RELATIONSHIP TO HEAD OF HOUSEHOLD:
01 = HEAD
02 = WIFE OR HUSBAND
03 = SON OR DAUGHTER
04 = SON-IN-LAW OR DAUGHTER-IN-LAW
05 = GRANDCHILD
06 = PARENT
07 = PARENT-IN-LAW
08 = BROTHER OR SISTER
09 = NEPHEW OR NIECE
10 = CO-WIFE
11 = OTHER RELATIVE
12 = ADOPTED/FOSTER/STEPCHILD
13 = NOT RELATED
98 = DON'T KNOW

** Q.10 THROUGH Q.13
RECORD '00' IF PARENTS NOT LISTED IN HOUSEHOLD SCHEDULE.

*** CODES FOR Qs. 15, 16 AND 20
EDUCATION LEVEL:
0 = NURSERY, KINDergarten
1 = PRIMARY
2 = SECONDARY
3 = HIGHER
8 = DON'T KNOW
EDUCATION GRADE:
00 = LESS THAN 1 YEAR COMPLETED
98 = DON'T KNOW
<table>
<thead>
<tr>
<th>LINE NO.</th>
<th>PARENTAL SURVIVORSHIP AND RESIDENCE FOR PERSONS LESS THAN 16 YRS OLD</th>
<th>EDUCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IF ALIVE (NAME)’s natural mother alive?</td>
<td>IF AGE 5 YEARS OR OLDER</td>
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<tr>
<td>(10)</td>
<td>(11)</td>
<td>YES NO DK</td>
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<td>11</td>
<td>1</td>
<td>2</td>
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<td>12</td>
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</tbody>
</table>

Just to make sure that I have a complete listing:

1) Are there any other persons such as small children or infants that we have not listed?
   IF YES, ENTER EACH IN TABLE
   NO

2) In addition, are there any other people who may not be members of your family, such as domestic servants, lodgers or friends who usually live here?
   IF YES, ENTER EACH IN TABLE
   NO

3) Are there any guests or temporary visitors staying here, or anyone else who slept here last night, who have not been listed?
   IF YES, ENTER EACH IN TABLE
   NO

TICK HERE IF CONTINUATION SHEET USED
Your project has been approved by the IRB.

Project Title: Waterborne Diseases: A Cry of a Trapped Community

Approvers Comments:

Dear Mr. Mudundulu and Dr. Nam,

Project #11767 titled, “Waterborne Diseases: A Cry of a Trapped Community” has been approved. You are authorized to begin your research.

Your stamped and approved informed consent form has been uploaded to NUgrant. Please use this form to make copies to distribute to participants. If changes need to be made, please submit the revised informed consent form to the IRB for approval prior to using it.

Your project was approved as an Expedited protocol, category 6 & 7.

Please allow sufficient time for the official IRB approval letter to be available within NUgrant.

Cordially,

Rachel Wenzl
Research Compliance Services Specialist
Human Research Protection Program
23 June 2011
HR3/340/2531/TDO/MC-qtc

Mr. Passmore Mudundulu
Graduate Student – CRPL, MSW
Community and Regional Planning
N University Nebraska - Lincoln

Dear Sir,

RE: PERMISSION TO INTERVIEW PEOPLE IN THE STUDY AREA

Reference is made to the above subject.

This serves to notify you that permission has been granted to you to proceed to interview people in the study area in accordance with your request.

However, the permission is subject to the following conditions:

(i) An undertaking by yourself that information gathered will be used for academic research purpose only.

(ii) Lusaka Water and Sewerage Company will be availed the research output in form of your final report.

In order to formalize authorization, you are advised to contact the undersigned.

Yours faithfully

W M Siane
DIRECTOR HUMAN RESOURCES AND ADMINISTRATION