

**ACCESSIBILITY AND UTILIZATION OF WATER AND SANITATION  
SERVICES IN URBAN AREAS: A CASE OF MWANZA CITY, TANZANIA**



**BY**

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**FOR REFERENCE  
ONLY**

**A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE  
REQUIREMENT FOR THE DEGREE OF MASTERS OF ARTS IN RURAL  
DEVELOPMENT OF SOKOINE UNIVERSITY OF AGRICULTURE  
MOROGORO, TANZANIA**

**2007**

## ABSTRACT

This study was conducted in Mwanza City and the objective was to determine the factors that influenced accessibility and utilization of water and sanitation services. A cross-sectional study design was employed. Statistical Package for Social Science software was used in data analysis. The study found that 87% of the 231 households had access to safe drinking water. In urban areas, 53.6% of the 183 households had piped water connections. Of households 106 in planned urban settlements, 54.6% had access to piped water services compared to 35.6% of the 51 households in the hilly squatter settlements indicating that household location influenced access to water services ( $p < 0.001$ ). Overall, 78% of the 231 households obtained water within 400 metres and 24.2% of the households spent 30 minutes or less to fetch water from the source. About 91% of the households had access to water within 400 metres compared to 29.2% of peri-urban households suggesting that urban residents spent less time to fetch water ( $p < 0.001$ ). Of the 231 households, 97% had toilet facilities and 61 % owned traditional and pour flush pit latrines. About 13% of the 48 peri-urban households had no toilet facilities. Of the urban 183 households, 6.5 % had flush toilet connected to the sewerage system. Typhoid fever was the commonest water-borne disease and the household's socio-economic status influenced the prevalence of gastro-enteritis in children ( $p < 0.000$ ). From this study, the following recommendations were made: extension of the piped water network to developed and squatter settlements; adoption of sustainable water resources conservation and water pollution control measures; community awareness creation on the prevention and control of water-borne diseases; involvement of the private sector in the provision of sanitation services and use of roof tops rain water harvesting technology; and conducting research to determine the factors for low rate of sewerage subscription.

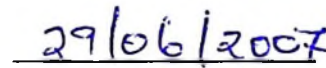
**DECLARATION**

I, YOHANA DAUD SAGENGE, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work, and that it has not been submitted, nor concurrently being submitted for a degree award in any other university.



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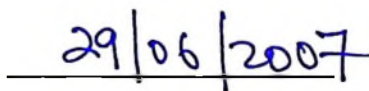
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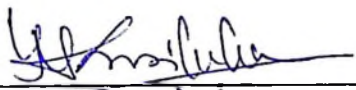


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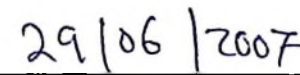


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## ACKNOWLEDGEMENT

This work is a result of contributions from a number of institutions and individuals whom I should acknowledge. I appreciate their mutual and material support and efforts that assisted me in preparing and accomplishing this dissertation. I would like to express my heartfelt gratitude to my supervisors; Prof. Mtambo, M.M.A and Prof. Kusiluka, L.J.M who critically reviewed the manuscript and for their tireless guidance, encouragement and assistance in making this dissertation successful.

Thanks also are extended to the District Executive Director for Sengerema District Council and the District Agriculture Development Officer (DALDO) for their cooperation and supplementary funding that enabled me to undertake my study at SUA. Thanks are also extended to my parents who laid down the educational foundation for my present academic achievements.

In data collection, I owe special thanks to the following: Mr P. Baruti, the Director, Mwanza City Council who offered the permission to collect primary and secondary data from various sources in his area of jurisdiction; Engineer Z. Mihayo, the MWAUWASA Director, for his permission to use the authority's documentations and assigning one of his staff to assist me in accessing primary and secondary data for this study; Mr J. Kapizo, the Mwanza City Health Officer, who provided me with current information on the status of City health and sanitation services in Mwanza City; the Ward Executive Officers (WEO), Village Executive Officers (VEO), street and village chairpersons, and respondents in all the wards, villages, streets and households respectively where data were collected for enabling me to carry on data collection and Mr J. Sima and his family who provided

accommodation during the whole period of data processing, analysis and developing the manuscript, their contribution is highly appreciated.

I am indebted to my family, who missed my presence at home and provided a constant encouragement during the whole period of this study. Lastly, my sincere thanks should go to the Development Studies Institute (DSI) staff and my fellow students, Mr F. Mapunda, Ms E. Mbapila, Mrs O. Swai, Mr P.S. Malala and Rev. E. Falanta (Chaplain of SUA CCT) to mention a few, for their cooperation, encouragement and moral support during my stay at Sokoine University of Agriculture (SUA).

## **DEDICATION**

This work is dedicated to my beloved wife Nterindwa E. Muiyanza for her encouragement, patience and tolerance; and to our lovely sons and daughters: Fortunatus Yohana, David Yohana, Joana Yohana and Janeth Yohana for missing my love and care during my study at SUA.

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## LIST OF ABBREVIATIONS AND SYMBOLS

AIDS	Acquired Immunodeficiency Syndrome
CBEM	Capacity Building Environmental Management
df	Degree of freedom
DSMS	District Subject Matter Specialist
FHH	Female headed household
HBS	Household Budget Survey
HESAWA	Health through Sanitation and Water
Hh	Household head
HIV	Human Immunodeficiency Virus
IIED	International Institute for Environment and Development
LVEMP	Lake Victoria Environmental Management Programme
m	Metre
MCC	Mwanza City Council
MDGs	Millennium Development Goals
MKUKUTA	Mkakati wa Kukuza Uchumi na Kuondoa Umaskini Tanzania
MHH	Male headed households
MWAUWASA	Mwanza Urban Water and Sewerage Authority
NBS	National Bureau of Statistics
NGO	Non-Governmental Organization
NSGRP	National Strategy for Growth and Reduction of Poverty
PRSP	Poverty Reduction Strategy Paper
p	probability
REPOA	Research for Poverty Alleviation
SADC	Southern Africa Development Community
SPSS	Statistical Package for Social Sciences
SUA	Sokoine University of Agriculture
TAS	Tanzania Shilling
TRCHS	Tanzania Reproductive and Child Health Survey
UWSAs	Urban Water and Sanitation Authorities

UN	United Nations
UNICEF	United Nations International Children Education Fund
URT	United Republic of Tanzania
VEO	Village Executive Officer
WB	World Bank
WEO	Ward Executive Officer
WHO	World Health Organization
WUGAs	Water Users Group Associations
WRI	World Resources Institute
$\chi^2$	Pearson Chi-square

## CHAPTER ONE

### 1.0 INTRODUCTION

#### 1.1 Background

More than 70% of the earth's surface is covered by water, yet despite this plentiful supply of water on earth, access to clean drinking water remains a major challenge for a large proportion of the world's population (Enviro-literacy, 2004). The world's rapid population growth is the major factor in increasing water demand for household consumption. In urban areas, high demand for water is due to unplanned urbanization caused by natural population growth and migration that result into great impact on the availability and quality of water resources (UN-Habitat, 2003; SADC, 2000). Increased demand for water leads to overuse of water sources, causing reduction and pollution of surface and groundwater supplies. While freshwater crisis appears inevitable in many water-deprived cities, many countries with water-stressed urban areas are introducing better pricing mechanisms and fostering community-based water management schemes (Abramovitz, 1996; WRI, 1987). However, both the number and scale of these activities need to be increased substantially by formulating appropriate policies and strategies for sustainable water and sanitation services delivery.

Following the adoption of the United Nations Millennium Declaration in 2000 and the World's Summit on Sustainable Development Resolutions in 2002, most governments and international agencies have committed themselves to address the Millennium Development Goal (MDG) number 7. The goal aims at reducing by half, the proportion of people without sustainable access to safe drinking water and basic sanitation services by 2015 and improvement in the lives of at least 100 million slum dwellers by 2020 (UN-

Habitat, 2003). Despite such commitments, urban household water supply and sanitation remains a challenge not only to Tanzania but also to other parts of the world where more than a billion people are still getting drinking water from sources such as rivers, streams, swamps and unprotected wells that are considered to be unsafe (Water Aid, 2006; URT, 2002a)

Six years after the MDGs were set, the proportion of people without access to safe water worldwide decreased from 20% in 2000 to 17% in March 2006, and the proportion of population without basic sanitation decreased from 50% to 40% in the same period (World Bank, 2004; Water Aid 2006). Due to poor sanitation and drinking of contaminated water, over two million people mainly children die worldwide every year from gastro-enteritis and developing countries are most affected with such deaths occurring at every 15 seconds (WaterAid, 2006). In Africa, 62% of the population has access to improved water supply with rural areas coverage of only 47% compared to 85% in urban areas (WHO and UNICEF, 2000). In Tanzania, about 53% of the rural population has access to reliable water supply, but due to poor operational and maintenance problems over 30% of the rural water schemes are not functioning properly (URT, 2002b;URT, 2004a). Of the urban population, 73% have access to reliable water supply services and the rest are serviced by the ineffective Urban Water and Sewerage Authorities (URT, 2003a).

To address the problem of inadequate water supply and sanitation services, the Tanzania government launched the National Water Policy in 2002. The overall objective of the National Water Policy is to improve health and alleviate poverty through sustainable improved access to adequate safe water and basic sanitation. In the Water Policy the following basic issues are addressed: (i) improvement in delivery of water and sanitation

services in low-income urban and peri-urban areas (ii) infrastructure improvement for sustainable and efficient delivery of water and sanitation services and (iii) improvement of wastewater treatment and disposal in order to minimize contamination of ground water sources and the environment resulting from hazardous methods of public wastewater disposal through septic tanks and pit latrines. These objectives will be achieved by involving the local communities in the sustainable management of water resources and contributing more toward costs of improved water and sanitation services provision (URT, 2002b).

### **1.2 Problem statement**

Ensuring adequate and equitable water and sanitation services delivery is one of the most challenging problems in cities in developing countries. Rapid expansion of urban settlements in terms of space, population growth and economic development has created a serious problem in terms of demand for reliable, adequate water supply and sanitation services. In Tanzania, for example, despite the government's effort to decentralize water supply and sanitation services to Mwanza Urban Water and Sewerage Authority (MWAUWASA), the percentage of households in Mwanza City that uses piped drinking water supply decreased by 19.4% from over 90% in 1988 to 72.5% in 2002 (UN-Habitat, 2003; URT, 2004a).

In 1998, about 20% of the households in Mwanza City had water piped into their homes or their yards while households without water connection into their homes walked 600-750 metres to obtain drinking water (Zaba and Madulu, 1998). About 27.5% of Mwanza City residents do not have access to piped water supply; 4.2% depend on water vendors; 11.2% obtain drinking water from un-protected water sources and 8% households have no toilet facilities (URT, 2004a).

Inadequate water supply and poor sanitation services in Mwanza City and other urban areas on Lake Victoria shores contribute to high prevalence of water-borne diseases such as cholera, typhoid fever and dysentery especially during the rainy season (LVEMP, 2001). The diseases reduce the socio-economic performance of City dwellers thereby aggravating the poverty situation in the City. The prevalence of water-borne diseases and the high proportion of people without access to piped water supply call for research on how to alleviate the problem of water shortage in Mwanza City and other urban settlements along the Lake Victoria shoreline.

This study was carried out to establish the status of water supply and sanitation services provision in Mwanza City. The study was intended to assess and understand the factors that influence the delivery and utilization of water and sanitation services in urban and peri-urban areas and draw recommendations that could assist urban authorities and other stakeholders to formulate appropriate strategies for alleviation of the urban water and sanitation services problems.

### **1.3 Justification**

Priority need be given to water issues in Tanzania because access to adequate safe water and sanitation contributes significantly to poverty alleviation through improved health, reduced cost for medical treatment, increased education and economic opportunities (WaterAid, 2006). This study focused in the urban areas with Mwanza City Council (MCC) as a study case for urban water and sanitation services delivery. The choice of Mwanza City was based on the fact that the City's population was growing at a rate of more than 11% annually thereby exerting enormous pressure on existing social services including water and sanitation services (Kitundu, 2001). There are also evidences that

many rural settlements around Mwanza City are growing rapidly into trading centres with increase in population but very little or no collateral improvement in the levels of water and sanitation services provision (UN-Habitat, 2003; URT, 2002a). Furthermore, about one third of urban populations including Mwanza City residents live in unplanned or squatter areas with high population densities, poor hygiene and, depending on old and inadequate water and sanitation infrastructure (URT, 2002b). Also, the choice of alternative sources of water is more limited in urban than in rural areas.

Improvement in the urban water and sanitation services could contribute significantly toward achieving the MDG 7 by increasing the proportion of population with sustainable access to safe drinking water and attain a significant improvement in the lives of people living in squatter areas in Mwanza City. The present study was intended to provide data that would assist planners, policy makers, urban authorities, community based organizations, non-governmental organizations and environmentalists to formulate policies which could reduce the problem of water supply and sanitation in the City.

#### **1.4 Objectives**

##### **1.4.1 General objective**

The general objective of the study was to determine the factors that influence delivery and utilization of water and sanitation services in Mwanza City in order to assist urban authorities and other stakeholders to formulate appropriate strategies for alleviation of the urban water and sanitation problems.

### **1.4.2 Specific objectives**

The specific objectives of this study were:

1. To determine the major constraints to MWAUWASA and MCC towards effective and equitable delivery of water and sanitation services
2. To assess the perception of Mwanza City residents on water services availability and their participation in sustainable management and maintenance of water resources
3. To assess whether the households' location influences the accessibility to water and sanitation services
4. To determine the prevalence of water-borne diseases and their effects on social performances of City residents.

### **1.4.3 Hypotheses**

#### **1.4.3.1 Null hypotheses**

- (i) Household location does not influence significantly the City residents' accessibility to water and sanitation services.
- (ii) Socio-economic factors have no influence on the prevalence of water-borne diseases among City residents

#### **1.4.3.2 Alternative hypotheses**

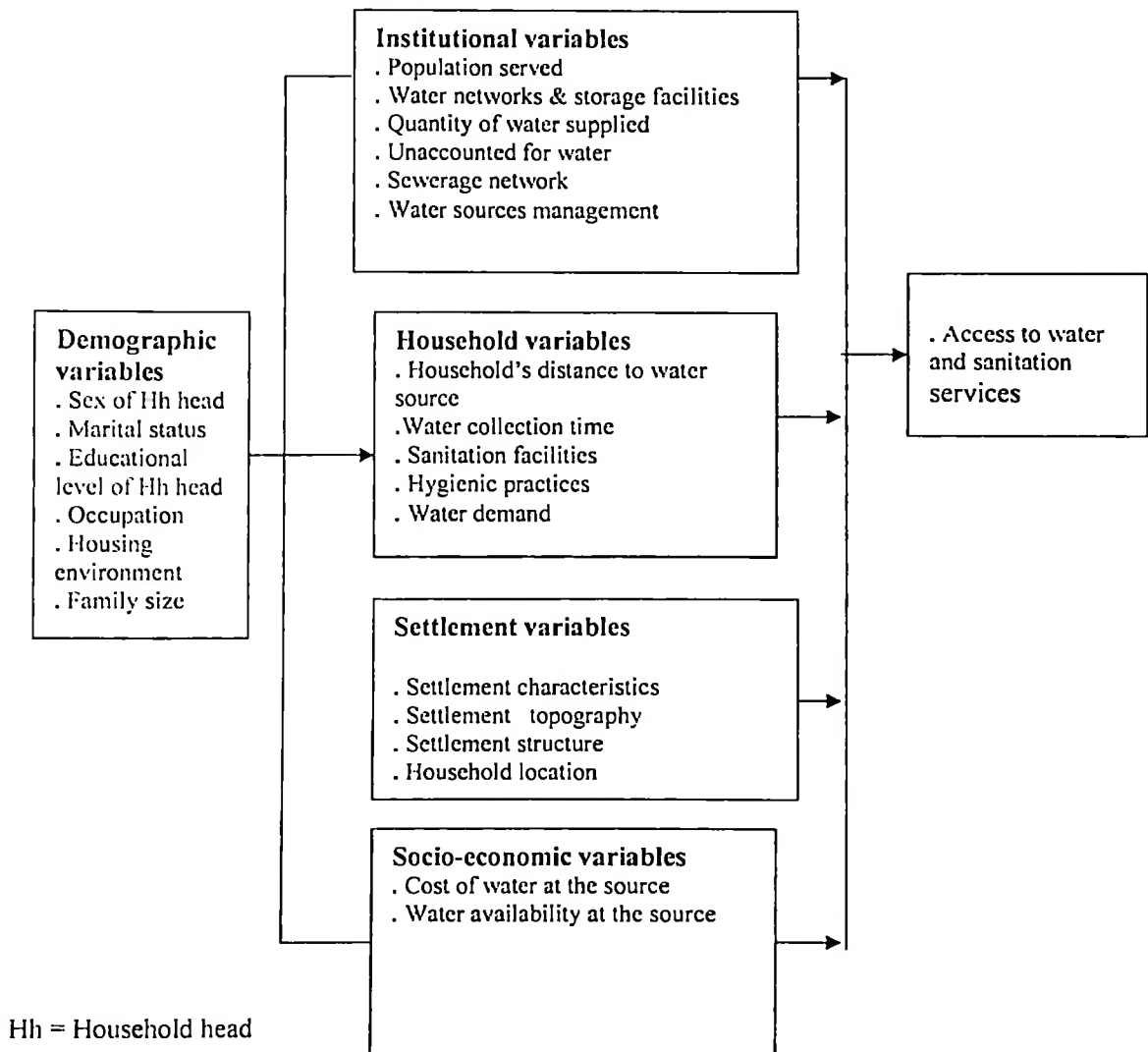
- (i) Household location influences significantly the City resident's accessibility to water and sanitation services
- (ii) Socio-economic factors influence the prevalence of water-borne diseases among City residents

#### 1.4.4 Conceptual framework

This study assumed that dependent variable “accessibility and utilization of water and sanitation services” in urban areas was influenced by interplay of independent variables. The independent variables include size of population served, resource availability, capacity of water storage facilities, quantity of water supplied, water loss, percentage of population served, distance to water source, sanitation facilities, sewerage facilities, water demand, residence (settlement topography; settlement structure; settlement characteristics), cost of water, family size and water availability at the source.

- (i) The quantity of water supplied, capacity of water storage facilities and water losses: The accessibility and utilization of water services depend on the quantity of water supplied and are affected by the capacities of water storage facilities and the amount of water lost through leakages (unaccounted for water). If the water storage is not adequate or an unaccounted for water is high, a low proportion of the population will be served in a given area. Low water supply reduces per capita water consumption and even the accessibility to the water sources, as water might not be available in some of the water taps.
- (ii) Size of population served/water demand, the distance to water sources and cost of water: Utilization of water services depends on the proportion of population served and on the distance from the households to the water sources, especially public water taps. Large population size requires an adequate amount of water to meet its daily demands. Households located near water sources have higher per capita water uses compared to households located far from the sources. High cost of water causes reduced household water consumption because people try to save money for other domestic requirements.

- (iii) **Resource availability:** Funding and technical staff affect the day-to-day activities of the water supply organizations thereby affecting water availability to consumers. A reliable source of funding and availability of skilled technical staff enable the water and sanitation utility to meet expenses on various items such as spare parts, construction of distribution lines, wages and salaries for workers and smooth running of such equipment /machines.
- (iv) **Settlement:** Accessibility and utilization of water services depends on the location of the household. Accessibility and utilization of water and sanitation services among households located in hilly, squatter settlements and peri-urban areas differ from households located in low lying and surveyed urban settlements. In high density settlements, there are many people sharing the same water source and in case of settlement located in hilly areas, water might not be available regularly in some water sources due fluctuations in piped water pressure from the main supply. For most urban areas, settlements located at the centre are better served with adequate water infrastructures and sewerage facilities since there might be inadequate resources to extend the services to the peri-urban areas. Figure 1 illustrates the conceptual framework on constraints towards water and sanitation services provision.



**Figure 1: Conceptual framework: Constraints toward adequate water services delivery in urban areas**

## CHAPTER TWO

### 2.0 LITERATURE REVIEW

#### 2.1 Overview

Water supply and sanitation services are very closely related and necessary at individual and community level. Adequate water supply and sanitation contribute significantly towards poverty alleviation through promotion of personal and environmental hygiene (URT, 2005a). Inadequate or lack of clean and safe water for domestic use leads to the transmission of water-borne and water-washed diseases. Water-borne disease transmission occurs by drinking contaminated water. Water-borne diseases include typhoid, viral hepatitis A, cholera, amoebic dysentery and dracunculiasis (Guinea worm disease); and water-washed diseases occur when there is a lack of sufficient quantities of water for washing and personal hygiene (WHO and UNICEF, 2000).

According to WHO (1997), access to safe water in urban areas refers to availability of public water tap located within 200 metres of the household. It is measured by the number of people who have reasonable means of getting adequate amount of clean water, about 20 litres per person per day expressed as a percentage of the total population. On the other hand, adequate sanitation provision refers to the share of the population with at least one excreta disposal facility and bathing facility for personal hygiene in each house or apartment and for flush toilet facility, water must be available 24 hours (WHO, 1997). In the Tanzanian context, improved water provision refers to provision of sufficient, safe water for the people at a distance located within 400 m from the homestead and servicing 250 people per outlet (URT, 2002a). At least 25 litres of portable water per day per capita must be available from the source year round. Safe or improved water sources include

piped water; deep and shallow wells fitted with hand pumps; water from protected wells (by enclosing the source and covered springs) to prevent contamination by run-off water (URT, 2002b; URT, 2005b; WHO and UNICEF, 2000). For sanitation provision, improved provision refers to the proportion of households owning and using toilet facilities (URT, 2002a; IIED, 2003; URT, 2003a).

The World Bank and National Water Policy definitions on access to safe water in urban areas do not consider time taken for collecting water from the sources. Pressure on water sources, queuing for water in addition to distance covered adds extra cost for the time and productive energy levels on the water collectors, usually women and girls (Zaba and Madulu, 1998). Therefore, time taken for collecting water provides a true reflection on the burden of domestic water collection and offers an insight on the extent of water problems in various settlements.

## **2.2 The status of water and sanitation services in the Least Developed Countries**

Studies indicate that, at the global level, the Least Developed Countries did little to improve safe water and sanitation services provision in the urban areas compared to the Developed Countries in relation to the MDG 7 of reducing by half the proportion of people without access to safe drinking water by 2015 (UN-Habitat, 2003). For example, in 2000, there were 174 million urban dwellers without access to safe water provision of which 56.3% were in Asia; 25.3% were in Africa; 16.7% were in Latin America and Caribbean and only 1.7% of the urban dwellers were in Europe (UN-Habitat, 2003). During the same period, 13% of the Latin America and Caribbean urban population; 22% of the Asia urban population; and 16% of African urban population did not have access to basic sanitation facilities.

However, the situation is much better among the East African states. For example, the average coverage for safe water and basic sanitation provision by the year 2000 for East African Countries were 80% and 97% respectively. Among East African states, Tanzania provided 80%, Kenya provided 87% and Uganda provided 72% of their urban populations with safe water services in the year 2000 (WHO and UNICEF, 2000). Also, during the same period, 98% of the urban populations in Tanzania and 96% of urban population in Kenya and Uganda had access to basic sanitation services. In the year 2004, only 75.3% of the urban population in Tanzania mainland had access to safe water and 97.6% of them had access to basic sanitation facilities (URT, 2005b). The decrease in the proportion of urban population with access to safe water from 80% in 2000 to 75.3% in 2004 is attributed to high population growth rate in urban areas and development of unplanned settlements that overstretch the available water services (URT, 2002a).

### **2.3 Causes of water and sanitation problems in urban areas**

The aging of water supply infrastructure, inadequate maintenance and increased pressure on the existing infrastructure due to increased industrial and domestic demand are the factors that result into inadequate water supply in urban areas (IIED, 2003). Studies have shown that about quarter to half of urban water supply remains unaccounted for, significantly reducing the amount of water available in some areas and increasing the queuing time at the source (World Bank, 2004). The increase in demand for domestic water supply in urban areas of Tanzania is attributed to the high population growth rate of 6% per annum caused by natural growth and rural-urban migration (URT, 2002a). The high population growth rate causes strain on the existing water supply infrastructures like water intake structures, water treatment plants, and main and storage tanks that are aged,

dilapidated and inadequate to meet the high demands of water and sanitation services (URT, 2002a; URT, 2003a).

#### **2.4 The magnitude of water and sanitation services problems in urban areas**

Worldwide, millions of urban dwellers have inadequate provision for water, sanitation and drainage services that contribute to a very large disease burden and premature deaths each year (UN-Habitat, 2003). About 32% of the urban African population does not have access to reliable water supply services (Kasisi, 2003) and more than 40% of the people in the SADC region have no access to safe water supply, predisposing them to avoidable water-related diseases that not only cause high mortality, but also lower the productivity of the people (SADC, 2002).

In Tanzania, there is evidence indicating a decline in the proportion of urban population and other parts of rural areas with access to piped water over the past two and half decades. For example, the urban population with access to piped water decreased from 88% in 1978 with 34% of them having piped water supply to 78% in 1988 with 27% households having piped water supply in their dwellings (Zaba and Madulu, 1998), down to 72.2% in the year 2000 (URT, 2000). The urban areas of Mwanza region also experienced a decline in the population with access to piped water supply from 82% in 1978 to 66% in 1988, and in Mwanza City, the proportion of households using piped water decreased from 90% in 1988 (Zaba and Madulu, 1998) to 72.5% (95 % in Nyamagana and 50% and Ilemela district) of the households (URT, 2004c). Currently, 18.6% of the urban households have piped water in their dwelling or yard, 15.5% households depend on water obtained from public tap and 32.8% from neighbour's tap (URT, 2005b). The decline has been associated with the rapid population increase (URT, 2002a) and changes in the

national water policies from “free water for all” in the 1970s through the 1980s to “cost-sharing” in the 1990s up to 2000s (Madulu, 2000; IIED, 2003). In the peri-urban areas of Mwanza City, protected wells are the main sources of drinking water accounting for 25% of the sources. In the two districts, the traditional pit latrine is the most commonly used toilet facility accounting for 73% households in Nyamagana and 71% in Ilemela. About 3% and 5% of households had no toilet facilities in Nyamagana and Ilemela districts respectively.

## **2.5 The consequences of poor water and sanitation services in urban areas**

### **2.5.1 Effects on human health**

According to the WHO and UNICEF report (2000), in the developing world, approximately 15% of all child deaths under the age of five in developing countries occurs due to gastro-enteritis each year and intestinal worms infect about 10% of the populations. About 6 million people are blind from trachoma and 200 million people in the world are affected with schistosomiasis. In Tanzania, inadequate sanitation at the household and community level contributes to about 12% prevalence of gastro-enteritis among children of less than five year of age (URT, 2003b). Water shortage in urban centres causes some of the households to depend on low quality water obtained from unsafe sources, predisposing the lives of the people to the risk of water-borne infections (Nyenza, 2002). Moreover, water inadequacies cause long queues at water sources and some people walk long distances to obtain drinking water for their families. The distances covered to collect water and the numbers of trips per day members of household make cause headache, general fatigue and pains to women and children (Simon le Grand, 2002; UN-Habitat, 2003). In Dar-es-Salaam, for example, due to pressure at water points, women and girls return to their homes at late hours and some of them submit to unsafe sexual practices as a

means of getting water from the sources owned by men (Kasisi, 2003). Such practices predispose women, girls and men to sexually transmitted diseases such as HIV/AIDS.

The persistent cholera episodes in Dar-es-Salaam City for the year 2002 and 2003 (Mboera and Rumisha, 2004) exemplify the inefficiencies in waste disposal and the consequent contamination of water sources and the environment. It is the poorer households living in un-piped urban areas or areas with erratic piped services that are exposed to contaminated water sources. In Mwanza City, inadequate water and sanitation provision contributes to high prevalence of water-borne diseases such as cholera, typhoid fever and dysentery especially during the rainy season (LVEMP, 2001). The diseases reduce the socio-economic performance of City dwellers thereby aggravating the poverty situation in the City.

#### **2.5.2 Burden on women and girls**

Water shortage in urban areas results into more time being spent on queuing at water sources, walking longer distances on difficult terrain to and from water sources (URT, 2003b). Increased number of trips each household makes per day to collect water adds more costs in terms of time and productive energy loss that reduces time for productive and reproductive activities (IIED, 2003). In Tanzania, water for domestic uses is commonly fetched by women (75%) and girls (20%), with men accounting for only 5% (Rugumamu, 1999). Lack or inadequate clean and safe drinking water reduces the children's time for schooling caused by water fetching activity that result into low school attendance among girls and hence lowers their academic performance (Nyenza, 2002).

### **2.5.3 Effects on household's water consumption**

It is well documented that improved accessibility to water services increases the people's water consumption. Studies indicate that, if water is available through a house or yard connection, people will use large quantities for hygiene, but consumption drops significantly when water has to be carried from a distant source to the household (WHO and UNICEF, 2000).

Among households without piped water supply, households that are closer to the water source collect water more frequently than those staying far from the source because water use tends to be higher very near the sources (Bhattacharya, 1998). Urban households consume, on average, more water than households in the peri-urban areas because there are good piped water supply networks in urban settlements. For example, a study conducted in Dar-es-salaam, Moshi, and Dodoma found that the mean daily per capita water consumption in piped households was 80.2 litres while for the un-piped households was 18.6 litres (IIED, 2003). This indicates that the quantity of water people use depends upon the easiness of access to it.

### **2.5.4 Effects on household expenditures**

Household demand for water significantly depends on the price of water because the cost of water influences the daily per capita water uses among un-piped households. Studies have shown that the nature of the area (whether urban or rural) to be provided with water, the social status of the people served and the institutional arrangements have an influence in determining the price of water (IIED, 2003). However, poor people bear a disproportionate burden of the impact of inequitable practice of subsidizing piped water services because inefficient water and sanitation services providers take advantage of poor

peoples' lack of choice of affordable source of potable drinking water (World Bank, 2004).

Studies have indicated that, adequate access to safe drinking water and sanitation services contribute to livelihood improvement for urban households by decreasing their living costs, increases their income potential, and in most cases minimizing the susceptibility to water-borne diseases (Njau, 2002; Nyenza, 2002). People living in underprivileged urban and peri-urban areas rarely benefit from adequate water supply and sanitation services because they depend on water that is collected from kiosks or obtained from water vendors at a higher price than that of house connections (URT, 2002a). This deplete their financial resources needed for other basic needs such as food, medical services, school fees, clothes, and house rent. Furthermore, urban households in densely populated settlements with erratic piped water services are forced to spend more of their income on water than households with water connections (IIED, 2003; URT, 2002a). The consequence of inadequate water provision is that low-income urban dwellers often pay high prices for purchasing low quality water from vendors at 2 to 50 times the price per litre paid by the high-income groups, who receive subsidized piped water in their homes (URT, 2002b).

## **2.6 Water and sewerage services provision in Tanzania**

The Tanzanian vision for urban water supply and sewerage (UWSS) sub-sector is to have autonomous, financially self-sustaining Urban Water Supply and Sewerage Authorities (UWSAs) in urban centres with 100% water supply and 50% sewerage coverage by the year 2020 (URT, 2003a). To achieve this, the government, through the National Strategy for Growth and Reduction of Poverty (NSGRP) or MKUKUTA set operational targets for UWSAs services delivery. The NSGRP priorities are to increase access to clean, safe

drinking water for the urban population from 73% in 2003 to 90% by the year 2010 and for sanitation, increased urban access to improved sewerage facilities from 17% in 2003 to 30% in 2010 (URT, 2005b).

The situation for urban sewerage system is grossly underdeveloped because of the 20 regional urban centres, only 45% of them have sewerage systems. In the remaining urban centres, about 90% of the households depend on onsite sanitation that include septic tanks, ventilated improved pit latrines; pour flush latrines, flush latrines and simple latrines (URT, 2003a; URT, 2005b) making them more susceptible to water and sanitation-related diseases. With regard to water services, 78% of urban households obtain piped water for domestic uses within 400 metre spending about 30 minutes on the journey to collect water from the nearest source while the remaining population uses other sources ranging from shallow and deep wells, direct from ponds, rivers or streams (URT, 2003c; Njau, 2002). Despite a considerable achievement in urban water services provision, the overall performance of most UWSAs is inadequate. Table 1 shows the performance of 18 UWSAs during the year 2002-03.

**Table 1: Water production (000'm<sup>3</sup>/day) and metered connections for the year 2002/03**

UWSA	Water production		Number of connections and metres			
	m <sup>3</sup> /day	Production/demand (%)	Total connections	Metered connection	Working metres	(%) meter connection
Arusha	32.0	76	17327	15096	14994	87.0
Moshi	26.0	119	10940	10940	10940	100.0
Mwanza	40.0	77	14515	11457	11245	79.0
Tanga	29.0	92	12421	11209	11026	90.2
Mbeya	25.0	81	9759	2420	2185	25.0
Morogoro	25	77	14141	8633	7749	61.0
Tabora	12.5	59	7743	3988	3984	51.5
Kigoma	10.8	57	6388	2382	6388	37.3
Dodoma	26.0	80	10798	9254	8081	85.7
Bukoba	6.6	88	3389	1708	1701	50.4
Iringa	12.6	79	5993	1845	1796	30.8
Lindi	1.0	15	1787	165	128	9.2
Mtwara	5.4	45	4229	1916	1906	45.3
Musoma	15.8	68	5112	1105	1016	21.6
Shinyanga	8.2	52	4211	914	836	21.7
Singida	3.4	46	2786	437	435	15.7
Songea	3.3	32	3240	421	314	13.0
S'wanga	5.0	65	278	708	691	25.5
<b>TOTAL</b>	<b>285.7</b>	<b>67.1(Average production)</b>	<b>137,559</b>	<b>84,589</b>	<b>80,954</b>	<b>61.49</b>

SOURCE: URT, 2003a.

The mean production capacity for the 18 Urban Water and Sewerage Authorities was 67.1% indicating that most of the UWSAs performed below the water demand in their respective areas. Given the performance of the UWSAs, and in order to achieve the NSGRP targets for the 2010, the rate of improvement in urban areas will have to be accelerated considerably through adequate allocation of resources for expansion and rehabilitation of existing facilities for urban water provision.

### 2.6.1 Water sources for domestic and economic activities in Mwanza City

Mwanza City is supplied with piped water mainly from Lake Victoria. About 430,500 (90.3%) of the 476,646 residents live in the water service coverage area. The total piped water network length is 209.96 km serving about 72% of the City (MWAUWASA, 2004).

An average of 42 000 m<sup>3</sup> of piped water is supplied per day, sufficient for more than 80% of the total daily demand for water in the two district that exceeds 52.000 m<sup>3</sup> per day. The composition of water subscribers by consumption categories is domestic 91%, commercial 6%, institutions 2% and industrial 1% (MCC, 2004). Besides the piped water supply, City residents also obtain water supply from 24 shallow wells, 23 protected springs and 4 bore holes located mainly in the peri-urban areas. According to the year 2002 Population and Housing Census, 97% and 72% of the households depended on piped, protected well or springs as their main sources of safe drinking water in Nyamagana and Ilemela district respectively (URT, 2004c).

### **2.6.2 Sanitation services**

The Government of Tanzania recognizes that in order to have a real impact in domestic water service, sanitation and hygiene should be promoted because a well constructed toilet facility and used effectively minimizes environmental contamination caused by improper waste disposal (URT, 2003b). The simple or traditional pit latrines and pour flush toilets are classified under one category of pit latrines and the flush toilet facilities include flush toilets with septic tanks or connected to the sewerage system (URT, 1997). For most of the urban settlements in Tanzania, the sewerage system is inadequate resulting into a large proportion of population to rely on an on-site sanitation (pit latrines and septic tanks) for wastewater disposal (URT, 2004b). In Mwanza City, sewerage coverage is only 7% with a network length of only 24 km (MWAUWASA, 2004). According to the 2002 Population and Housing Census report (URT, 2004c), the traditional pit latrine is the main type of toilet facility for 73% and 71% of the households in Nyamagana and Ilemela district respectively. Furthermore, 0.02% and 5% of the population in Nyamagana and Ilemela respectively do not have access to basic sanitation.

### 2.6.3 Population and economic activities

The 2002 Population and Housing Census recorded the population of 476,646 people for Mwanza City (about 210,735 and 265,911 people for Nyamagana district and Ilemela district respectively) with an annual population growth rate of 11.2%, of which 3.2% is due to natural growth and 8% due to rural-urban migration. The population density was recorded to be 134 people per square metre (URT, 2003b).

In 1997, about 41,705 hectares of land were within the township boundaries and the main land uses within Mwanza City were: residential (7.9%), institutional (3.1%), industrial (1.7%), commercial areas (0.2%) and special areas e.g. army (1.7%), open/agricultural and villages (66.5%) and the rest 19% were hills, forest reserves and open spaces (URT, 1997). Industrial and agricultural activities dominate the economy with more than 100 small to large-scale manufacturing and processing industries (Batara and Karangwa, 2002).

According to Mwanza City Council profile report (2004), about 40% of the City residents are self-employed; 33% are employed in the public and private sectors especially manufacturing industries (fish processing, cottonseed oil, breweries, soft drinks factories, bakeries, timber processing, garages, fabricating workshops, ginneries, foam and plastic factories, tanneries, soap making, quarry sites and animal feeds production); banking and transportation, and 27% are unemployed. Self-employed people are engaged mainly in trade and commerce, petty business, urban agriculture (small scale crop and livestock farming), fishing, sand mining and stone quarrying. In 2004, the average per capita income was US\$ 252 per annum (MCC, 2004).

#### **2.6.4 Housing and settlements**

Like in most urban areas in Tanzania, Mwanza City residents live in either planned or unplanned settlements. Of the 50,000 housing units found in the City, approximately 60% of them are built in unplanned areas mainly on the hilltops and hillsides and accommodate about 70% of the City population (MCC, 2004). The distribution of plot according to population densities in Mwanza City is as follows: high density, 43%; medium density, 26%; low density, 31% and unplanned 31% (URT, 1997). Most of the unplanned areas are found in the peri-urban wards and in hillsides and hilltops in the urban wards.

##### **2.6.4.1 Planned settlements**

According to the 2004 Mwanza City profile report, the planned settlements in the City comprise of low, medium and high population density areas. Majority of the residential areas in the City are composed of mixed type of settlements. On the basis of Mwanza Master Plan, the low population density areas have a maximum population density of 50 persons per hectare of serviceable land. The low population density areas are located in Isamilo, Nyamagana (around Capri-point), Ilemela (near lake shore), Pamba (around Bugando hill) and Pasiansi wards. The medium density areas with a maximum population density of 75 persons per hectare of serviceable land are mainly found in Nyamanoro, Kitangiri, Isamilo, Nyakato, Nyamagana (around the central business area), Kirumba, Pamba, Ilemela and Pasiansi wards. The high-density areas have a maximum population density of 200 persons per hectare of serviceable land. The high-density areas are inter-located among the low and medium population density areas in the urban wards.

#### **2.6.4.2 Un-planned settlements**

Squatter settlements are un-planned residential areas that are developed without legal claim to the land or permission from concerned authorities to build while slums are legal settlements but neglected part of the urban settlement (Mubvami, 2001). Squatter and slums are categorized as high population density areas and are characterized by high congestion of buildings, poor accessibility, inadequate physical infrastructures such as electricity, roads, piped water and sewerage networks, drainage networks, health facilities, landline telephones and lack of open spaces for recreation and solid waste collection. The hilly and valley settlements in Mwanza City are predominantly squatters, occupied mainly by low-income urban communities (CBEM, 1998). Upgrading of these settlements into planned areas by surveying is not possible because the Mwanza City Master plan stipulates the demolition of the squatter settlements located in the hillsides and hilltops and other reserve areas of the City.

## CHAPTER THREE

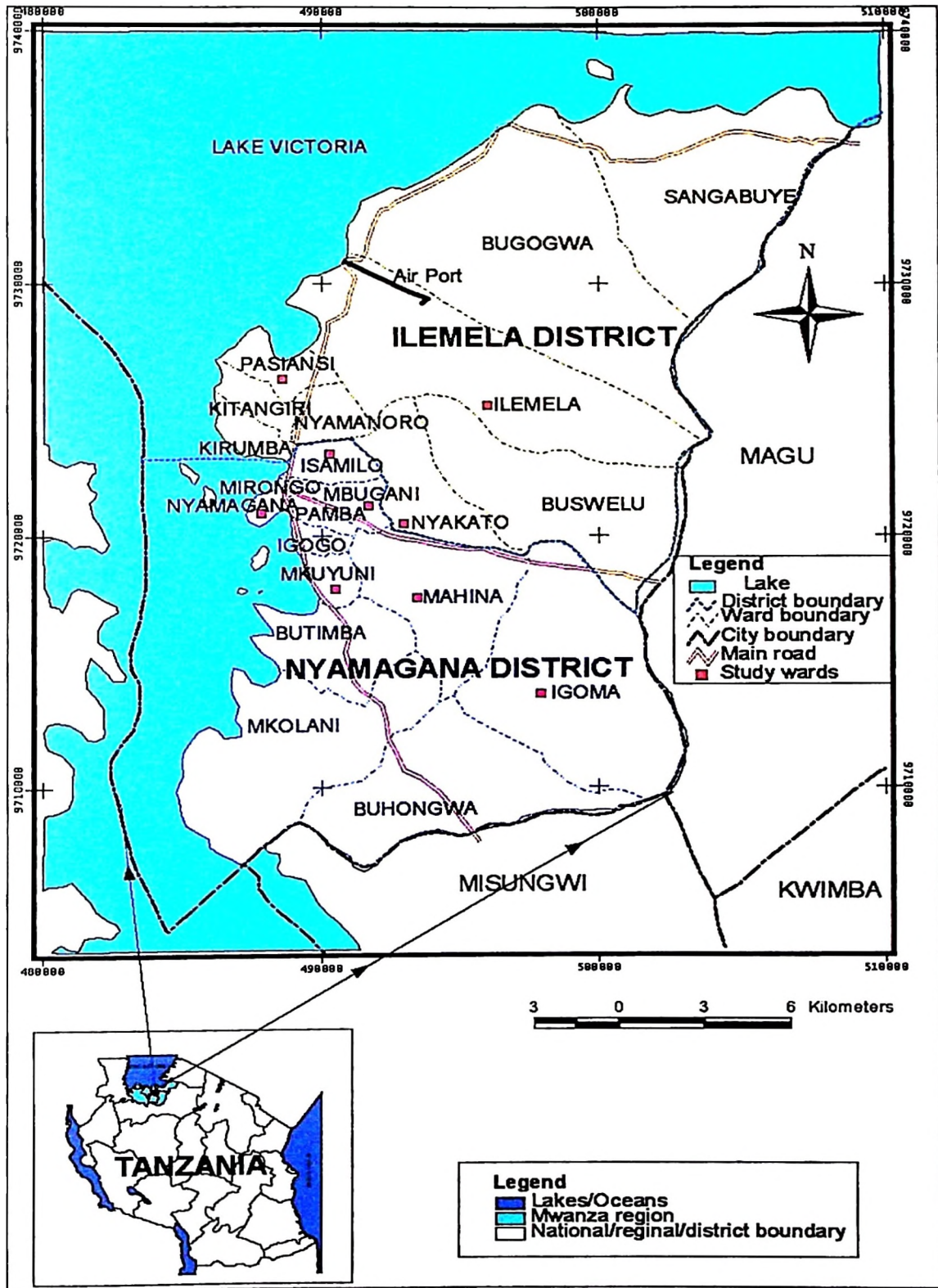
### 3.0 METHODOLOGY

#### 3.1 Study area

The present study was conducted in Mwanza City (Figure 2). There were 21 wards, 326 streets, 18 villages and 194 hamlets (sub-villages) in Mwanza City. The distribution of the wards, streets, villages and hamlets in the respective districts were as follows: in Ilemela district there were 12 wards, 6 villages, 198 streets and 94 hamlets; and in Nyamagana district there were 9 wards, 12 villages, 128 streets, and 100 hamlets (MCC, 2004). Administratively, the wards were categorized into peri-urban and urban wards respectively. In Ilemela district, peri-urban wards were Sangabuye, Bugogwa, Ilemela and Buswelu while urban wards were Kirumba, Kitangiri, Nyamanoro, Pasiansi, Nyakato. In Nyamagana district, the peri-urban wards were Igoma, Buhongwa, and Mkolani where as Pamba, Isamilo, Mkuyuni, Nyamagana, Mbugani, Butimba, Igogo, Mahina and Mirongo were the urban wards.

#### 3.1.1 Location and geographical description of the study area

Mwanza City is the headquarters for Mwanza region. It is located along shores of Lake Victoria and lies between latitude 2°15' and 2°45' South and between longitudes 32°45' and 33°0' East (Figure 2). It has a total area of 1,337 km<sup>2</sup> out of which 900 km<sup>2</sup> is under water and 437 km<sup>2</sup> is dry land intercepted by rocky hills. The temperature ranges between 18 °C and 34 °C, while rainfall ranges between 800 mm and 1200 mm per annum (MCC, 2004).



**Figure 2: Map of Mwanza City Council showing Nyamagana and Ilemela districts and the constituent wards.**

### 3.2 Research design

A cross-sectional study design was employed. The design allows collection of in depth data on different groups of respondents at one point at a time, which minimizes time and financial resources (Bailey, 1994). Data collection was conducted from October 2005 to January 2006. Interviews, questionnaires and review of official documents were used to collect data related to water and sanitation services in the study area.

#### 3.2.1 Sample size

The sample size was 213 households. These were obtained by determining the proportion of households with access to water services in the study area. The sample size was computed using the formula:  $n = z^2 pq/e^2$  (Kothari, 1990); where:

$n$  = required sample size,

$z$  = standard deviation corresponding to 95% confidence level = 1.96

$e$  = desired degree of accuracy = 0.06

$p$  = proportion of households accessible to water services in Mwanza City = 72.5%

$q$  = proportion of households not having access to water services ( $1 - p$ ) = 27.5%.

Hence,  $n = 1.96^2 \times 0.725 \times 0.275 / 0.06^2 = 213$

Other 18 households were added to the computed sample size of 213 households to make the overall sample size to be 231 households. This was done to compensate for 15 streets in Nyakato ward in Ilemela district that were reallocated to a newly formed Mahina ward in Nyamagana district in 2004.

### 3.2.2 Study population

This study covered nine wards, namely Ilemela, Pasiansi, Nyakato, Mahina, Igoma, Nyamagana, Mbugani, Mkuyuni and Isamilo. The household was the sampling unit of the study. The sample comprised of 231 respondents that were household heads and their spouses and/or other responsible family members. Included in the study were 87 respondents from Ilemela district and 144 respondents from and Nyamagana district (Table 2). Also 13 government staff, one from MWAUWASA office, one health officer from City health department, nine ward executive officers (WEOs) and two village executive officers (VEOs) were interviewed.

**Table 2: Distribution of respondents in the study wards in Mwanza City**

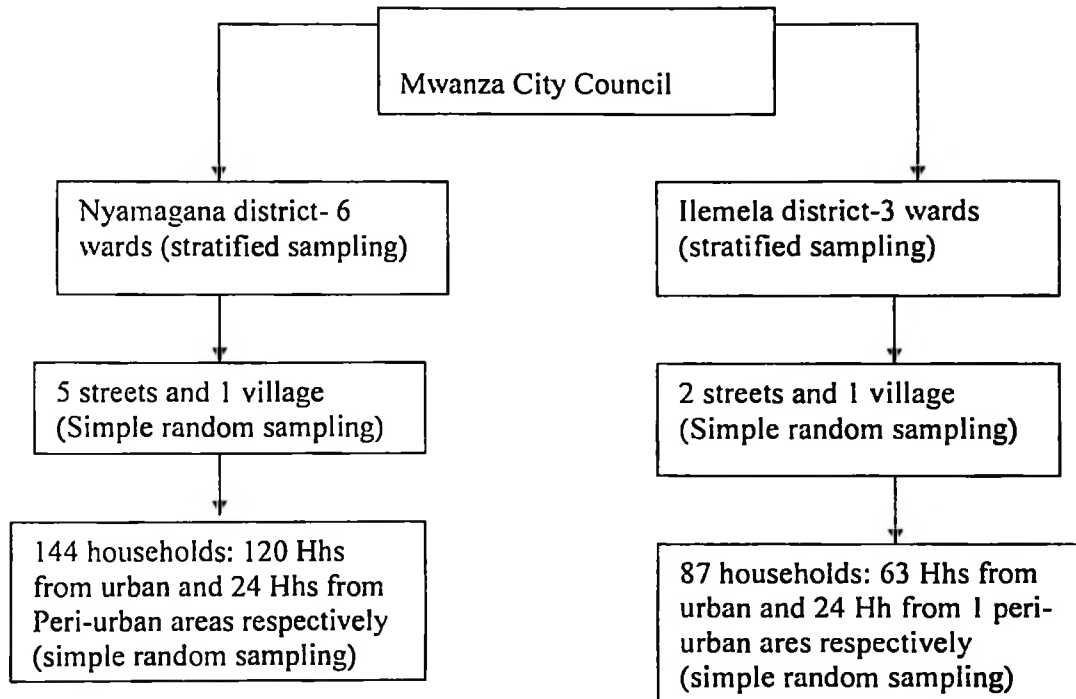
Ward name	Frequency (n = 231)	Percent
Igoma (peri urban)	24	10.4
Mahina	23	10.0
Ilemela (peri-urban)	24	10.4
Nyakato	34	14.7
Mbugani	25	10.8
Isamilo	23	10.0
Pasiansi	29	12.6
Nyamagana	26	11.3
Mkuyuni	23	10.0

### 3.2.3 Sampling procedure

The sampling frame consisted of 326 streets, 18 villages and 102,487 households in 21 wards in Mwanza City. Multistage sampling technique was used that involved three stages. In the first stage, stratified sampling was used to select six wards from Nyamagana

and three wards from Ilemela districts respectively. In the second stage, from each of the selected wards, a list of streets/villages was prepared by assigning each street or village a unique card with number starting from 0 in order to provide a sampling frame. The cards were mixed and put in two separate containers, one for streets and another for villages. From each container, seven streets and two villages (one street and one village from each of the urban and peri-urban wards respectively) were randomly selected by lottery method where one card was successively picked from the container at random until a sample size of seven streets and two villages was obtained. Finally, each of the randomly selected street was identified and categorized into residential areas having approximately the same density of residential structure (low, medium, high or squatter areas) per plot in order to identify the household location using survey maps that were available from the Mwanza City Council Planning Department. This categorization was useful in comparing the association between residential structure, place of living and household's accessibility to water and sanitation services. For each of the residential area, a list of households was obtained using the street registers with the help of street chairperson / ward executive officers.

From the sampling frame, 183 households (135 households from Nyamagana and 48 households from Ilemela districts) were selected by simple random sampling using a table of random numbers. For the peri-urban wards, village registers were used to obtain a list of the households in each village and from the list, 48 households (24 households from Nyamagana and 24 households from Ilemela districts) were obtained by simple random sampling using a table of random numbers. Schematic representation of the sampling procedure is shown in Figure 3.



Hh: Household

**Figure 3: Schematic representation of the sampling procedure**

### 3.5 Data collection

#### 3.5.1 Data collection instruments

A reconnaissance survey was conducted in each of the selected wards and villages in the study area a day before the interview. This was done in order to get acquainted with the area and to make appointments with the local leaders. The household interview for all the 231 households were carried out by the author.

(a) Pre-testing of questionnaires: The questionnaires for the key respondents' interview were pre-tested in October 2005 at Mwananchi Street in Nyamagana district using 10

respondents. After pre-testing, some of the questions were dropped, as they were found not relevant while other questions were added where it was deemed necessary.

### 3.5.2 Primary data

- a) Interviews: Structured questionnaires with both open and closed-ended questions were used to interview household heads and other household members (Appendix 1). These were supplemented by unstructured interviews with the MWAUSA network technician (Appendix 2) and Mwanza City Health Officer (Appendix 3). Questionnaires were administered to WEOs and VEOs to obtain data on water and sanitation services and infrastructures in their respective areas (Appendix 4). Also, the households' environment such as house possession, housing characteristics and source of energy for domestic use was examined. The information provided was collected to facilitate interpretation of the key demographic and socio-economic variables; and to assist in the assessment of the representativeness of the sampled households.
- b) Discussions with the local leaders and some respondents were conducted to obtain supplementary information on the water sources conservation activities and inventory of water and sanitation services infrastructure.
- c) Observation: Visits were made to various sites including Capri-point water sources, River Mirongo and River Mkuyuni-Nyanguganwa, and water sources like shallow and deep wells with water pumps and protected and un-protected water springs. Some photographs were also taken for reference.

### 3.5.3 Secondary data

Official documents including office files, national statistics reports and monthly and annual water development progress reports from MCC, MWAWAUSA, Ministry of Water and Livestock Development, ward and village executive's offices were reviewed.

### 3.6 Data processing

Data were coded and entered into the Statistical Package for Social Sciences (SPSS) software for storage and analysis (SPSS Inc., 2002). The SPSS software programme was used to determine the descriptive statistics such as percentages and frequencies of study variables. Study variables were compared statistically, these included: household location against household head's education level, marital status, and family size; main sources drinking water against household location, settlement characteristics and topography; distance to water source against household location, settlement characteristics, topography, water collection trips and respondents' view on water availability; water collection time against household location; possession of piped water and toilet facilities against household head's occupation and education level; occurrences of water-borne infections in children against household head's occupation, education level and sex. Cross tabulation of the study variables was made and Chi-square ( $\chi^2$ ) test was used for testing the hypotheses at 5% and 1% significance levels. Digital camera was used to produce the photographs and the arc View software programme was used for producing the map of Mwanza City. Microsoft Excel and Microsoft Word programmes were used to produce the pie charts and tables; and compilation of the report respectively.

## CHAPTER FOUR

### 4.0 RESULTS AND DISCUSSION

#### 4.1 Socio-demographic characteristics of the sample households

This section provides a descriptive summary of some of the demographic and social characteristics of the population in the sampled households that included education level, marital status, occupation of the household head and the family size.

##### 4.1.1 Characteristics of the respondents

Of the 231 respondents, 73 were males and 158 were females. The large proportion of women respondents in this study is attributed to the fact that most women are left at home performing most of the households' reproductive and non-reproductive roles including water fetching (Balihuta, 2001; URT, 2002b).

Of the 231 household heads, 84% of them were married and only 1.3% of them were divorcees (Table 3). Overall, 13.9% (n=32) households were female-headed (FHH) and 86.1% (n=199) households were male-headed (MHH). The proportion of female-headed households was slightly lower in peri-urban areas than in the urban areas. Of the 48 peri-urban households, 5.2% (n=12) were female-headed. In urban areas, of the 183 households, 8.7% (n=20) households were female-headed. The differences between male-headed and female headed households for the peri-urban and urban areas could be due to a large proportion of married household heads in urban areas where 91.3% of the 183 household heads were married compared to 79.2% of the 48 peri-urban household heads (Table 3).

**Table 3: Socio-demographic characteristics of the households in the study wards  
in Mwanza City**

Household's head education level	Household location		Percent
	Urban	Peri-urban	
No formal education	9	21	13.0
Primary education	105	23	55.4
Secondary education	26	1	11.7
Post secondary education	43	3	9.9
<b>Total</b>	<b>183</b>	<b>48</b>	<b>100.0</b>
$\chi^2 = 55.229$ ; df=3; p= 0.000			
Household's head marital status	Household location		Percent
	Urban	Peri-urban	
Married	159	35	84.0
Single	13	2	6.5
Widowed	10	9	8.2
Divorced	1	2	1.3
<b>Total</b>	<b>183</b>	<b>48</b>	<b>100.0</b>
$\chi^2 = 13.386$ ; df=3; p= 0.004			
Family size	Household location		Percent
	Urban	Peri-urban	
1-2	2	1	1.3
3-4	43	13	24.2
5-6	70	14	36.4
7-8	44	13	24.7
9+	24	7	13.4
<b>Total</b>	<b>183</b>	<b>48</b>	<b>100.0</b>
$\chi^2 = 1.555$ ; df= 3; p= 0.817			
Respondent's status	Household location		Percent
	Urban	Peri-urban	
Household head (males and females)	53	21	32.0
House wife	85	16	43.7
Daughter	22	7	12.6
Son	16	4	8.7
House girl	5	0	2.2
Others (sisters of the household head)	2	0	0.8
<b>Total</b>	<b>183</b>	<b>48</b>	<b>100.0</b>

#### 4.1.2 Household family size

The average family size in the study wards was 5.9 people. Of the 231 households, 24.2% (n= 56) had a family size of 3-4, 36.4% had a family size of 5-6, and 13.4% had a family size of over 9 members (Table 3). Overall, more households had family size of 5-6 persons category, of which 30.3% were located in the urban areas and 6.1% in the peri-urban areas

(Table 3). However, there was no significant difference in family size between peri-urban and urban households ( $p>0.05$ ).

According to Mbonile (2002), a household is defined as a person or group of people or those who share food, dwellings, and other essential services and goods; and it is measured by the number of household members. The size of the family is determined by socio-economic factors like fertility, mortality, income, place of residence and culture. In the past, the family size in the rural areas was large, predominantly extended and offered labour force for the household's labour social security for the elderly (Kamuzora, 2001; Kamuzora and Mkanta, 2002).

From the present findings, it is evident that, under recent social changes such as youth rural-urban migration, the peri-urban family structure seems to have decreased in average family size and possibly also its socio-economic functions. There are reasons that attract people to migrate from rural to urban areas. The growth of the informal sector such as small-scale enterprises in urban areas has significantly increased the rate of rural-urban migration (O'Riordan et al., 1997). Furthermore, Mbonile (2002); Zaba and Madulu (1998) found that people migrate from rural areas to urban areas due to lack of employment; hard economic conditions; family conflicts; death of spouses or parents; lack of social services such as health, education and safe water; inadequate land in the places of origin and retrenchment. On arrival in the urban centre relatives and friends who also help them to adapt to with new urban life accommodate majority of migrants. The average household size for Ilemela and Nyamagana districts are 5.0 and 4.3 persons respectively, with an average household size of 4.7 people (URT, 2004a). The present study, therefore, recorded a higher family size than the average national household size of 4.9 (URT,

2003c). More studies need to be carried out to establish the reasons for higher family sizes in Mwanza City.

#### 4.1.3 Educational level of the household head

The level of education of the households' heads was generally low. Out of 231 households' heads, only 31.6 % ( n= 73) had attained secondary and post secondary education (Table 3). Of the remaining households, 55.4% had primary education and 13% had no formal education. The statistical association between the two variables; household head education level and household location was highly significant ( $p < 0.001$ ) suggesting that the level of education was higher among urban household heads than those in peri-urban settlements. Mbonile (2002), found more or less the same education trend in Mwanza City where 51% of the people had completed primary education and 28% had not attained any formal education. Furthermore, the study findings confirmed that there was a gap in education acquired between urban and peri-urban residents where urban residents were more likely to have attended school for longer period than peri-urban residents.

Disparity in education status between females and males was also observed in the study wards. Of the 17 women household heads, 47.1% had no formal education compared to only 10.3% of the 214 male household heads that had not acquired formal education. About 5.9% of the 17 female household heads had attained secondary education and above, while 34% of the 214 male household heads had secondary education.

The above findings imply that the rate of education attainment was higher for men than for women. These proportions are more or less similar to the national statistics data (URT, 2000) where 24.2% of the women had no formal education, and only 8.6% of them had attained secondary education and above. Also the demographic health survey reported similar results for Mwanza region where 5.5% of women had attained secondary education

and above (URT, 2005b). This may in part, reflect the gender discrimination with respect to access to education where in the past, boys had more access to education than girls. The gender discrimination was based on socio-cultural factors such as loss of girl's labour force at the household level and also parents expected more benefits from educating their sons than their daughters (Mbelle and Kataro, 2003).

#### **4.1.4 Occupation of the household head and piped water connection**

In urban areas, of the 183 households' heads, 39.3% were employees and 30.6% were traders (Table 4). About 6.0% of them depended on agriculture and 13.6% household heads were engaged in petty business. In the peri-urban areas, agriculture was the main occupation, employing 87.2% of 48 household heads (Table 4). The finding implies that the peri-urban settlements are basically rural, depending on agriculture as their main economic activity (URT, 2005b).

Of the 231 household heads, 55.4% (n = 128) either had permanent employment in the public or private sectors or were engaged in business that gave them a reliable income for supporting their households. Of the 183 urban households in the study wards, 53.6% had piped water supply in their homes. Among the 98 households' heads that had piped water connection, 86.7% (n=85) were traders and employees in the public and private sectors. On the other hand, out of 98 urban households whose heads were engaged in petty business including the masons, welders and plumbers showed the lowest rate of piped water connection, 0.55%, followed by farmers that comprised 2.2% (Table 4). It is well documented that there is a close relationship between the household occupation and household's livelihood (Mwisomba and Kiilu, 2002; World Bank Group, 2001). There was a highly significant statistical association between household heads occupation and possession of household water connection in urban areas ( $p < 0.001$ ) implying that households that had reliable source of income were likely to subscribe for water services

than households without reliable income. There was no statistical comparison for peri-urban settlements because there was no piped water supply. In addition to occupation of the household heads, topography and settlement structure also influenced the City resident's subscription to piped water services in the study wards. Of the 166 respondents from the low lying settlements 44.6% had piped water connected to their homes or yards compared to 27.5% of the 51 respondents that lived in the hilly areas (Table 4).

**Table 4: Possession of piped water in relation to household's head occupation, settlement topography, characteristics and structure in Mwanza City**

Hh / head occupation	Possession of water connection		Percent
	Yes	No	
<b>Hh / head occupation –Urban (n=183)</b>			
Agriculture	4	7	6.0
Employed	48	24	39.3
Trading	37	19	30.6
Petty business	2	23	13.7
Retired officer	6	9	8.2
Manson, welder & plumber	1	3	2.2
<b>Total</b>	<b>98</b>	<b>85</b>	<b>100.0</b>
$\chi^2 = 33.087$ ; $df = 5$ ; $p = 0.000$ –urban			
<b>Hh / head occupation –Peri urban (n=48)</b>			
Agriculture	NA	41	85.4
Employed	NA	5	10.4
Trading	NA	1	2.1
Petty business	NA	1	2.1
<b>Total</b>	<b>-</b>	<b>48</b>	<b>100.0</b>
<b>Settlement topography (n=231)</b>			
Valley	10	4	6.1
Plain	74	92	71.8
Hilly	14	37	22.1
<b>Total</b>	<b>98</b>	<b>133</b>	<b>100.0</b>
$\chi^2 = 9.818$ ; $df = 2$ ; $p = 0.007$			
<b>Settlement characteristic (n=231)</b>			
Surveyed	77	32	47.2
Not surveyed	21	53	32.0
Peri-urban	0	48	20.8
<b>Total</b>	<b>98</b>	<b>133</b>	<b>100.0</b>
<b>Settlement structure (n=231)</b>			
High density	38	22	26.0
Medium density	23	8	13.4
Low density	17	2	8.2
Squatters and peri-urban	20	101	52.4
<b>Total</b>	<b>98</b>	<b>133</b>	<b>100.0</b>
$\chi^2 = 73.985$ ; $df = 3$ ; $p = 0.000$			

NA= Not applicable; Hh = household

About 71.0 % (n=77) of the 109 households located in planned areas had piped water connections and only 28.4 % (n=21) of the 74 households from unplanned areas had piped water connections. There was a significant statistical association ( $p < 0.005$ ) between piped water connection and residence (settlement topography, structure and characteristics) suggesting that apart from household's head occupation, factors like settlement topography, structure and characteristics influenced the household subscription to piped water services.

Comparing the present study findings and that of Zaba and Madulu (1998) for Mwanza City, the present study showed an increase of 33.6% households with water piped in their homes from 20% households in 1998 to 53.6% in 2005. In Dar-es Salaam and other urban areas of Tanzania, the National Bureau of Statistics reported that 74% and 42.7% of the households have piped water connections in their homes respectively (URT, 2000). It is apparent that, the proportion of households with piped water connection in Mwanza City was lower than that of Dar- es Salaam but above the national average for urban areas.

#### **4.1.5 Housing environment**

##### **4.1.5.1 Housing possession**

Of the 231 surveyed families, 67.5% (n=156) owned the houses they occupied and 32.5% of them lived in rented houses (Table 5). The house ownership rate in peri-urban areas was much higher than in urban areas where 91.5% (n=48) of the peri-urban families owned the houses they occupied compared to 61.4% (n=183) families in the urban areas. The easiness of house construction and low cost of construction materials used were the reasons for many peri-urban people to own houses. With regard to access to water and sanitation services, 61.2% (n=60) of the urban houses that were owned by the occupants

had piped water connection (Table 5). Furthermore, among 84 urban households that had flush toilet facilities, 65.5% (n=55) families owned the houses they occupied.

A house is an important asset and objective indicator of socio-economic status of the household. In urban areas, due to high prices of land, ownership of houses with adequate infrastructures such as piped water and properly maintained sanitation facilities is limited to households that earn reasonable income (URT, 2005b). Moreover, access to safe and clean water, properly maintained sanitation facilities and good shelter plays a critical role in supporting livelihood and good health (URT, 2005b). However, the statistical association between ownership of the occupied buildings and possession of piped water and flush toilet facilities was not significant ( $p>0.05$ ) implying that, in the study areas, house ownership had no influence on the possession of piped water services and sanitation facilities.

**Table 5: House ownership against possession of piped water and toilet facilities in the study wards in Mwanza City**

Infrastructure	Possession	House ownership	
		Owned	Rented
Piped water connection	Yes	60	38
	No	96	37
<b>Total</b>		<b>156</b>	<b>75</b>
$\chi^2 = 3.089$ ; $df= 1$ ; $p= 0.079$			
Toilet facility ownership	Pit latrine	67	17
	Pour flush	27	29
	Flush latrine	55	29
	No toilet	7	0
<b>Total</b>		<b>156</b>	<b>75</b>

$\chi^2 = 4.341$ ;  $df= 3$ ;  $p= 0.227$

#### 4.1.5.2 Housing characteristics

Respondents were asked on the type of materials used for flooring although no attempt was made to evaluate the cost of the houses. About 91% of the 183 urban households had their floors constructed using cement and for peri-urban settlement, 67% of the 48 houses had earth floors (Table 6). Of the 183 urban families that lived in houses with cement floors, 52.5% had piped water connection. Only 8.7% of the families that occupied buildings with earth floor had piped water connection. According to the URT (1999), the type of house flooring materials indicates the house quality and health risks to the tenants. Therefore, the types of construction materials were considered important factors in determining the socio-economic status of the household in the study wards. The statistical association between the type of house flooring materials used and the possession of pipe water among urban households was highly significant ( $p < 0.000$ ). The study findings probably suggest that families occupying good quality buildings with cement floors had better access to piped water services and could be less exposed to water-borne infections.

**Table 6: Percent distribution of households' characteristics according to residence and form of house ownership and possession of piped water in Mwanza City**

Hh characteristics	House tenure		Percent
	Owned	Rented	
<b>Floor material -urban (n= 183)</b>			
Cement	98	68	90.7
Tiles	1	0	0.6
Earth	13	3	8.7
<b>Total</b>	<b>112</b>	<b>71</b>	<b>100.0</b>
$\chi^2 = 3.670; df= 2; p= 0.160$			
<b>Floor material (peri-urban) ( n= 48)</b>			
Cement	12	4	33.3
Earth	32	0	66.7
<b>Total</b>	<b>44</b>	<b>4</b>	<b>100.0</b>
<b>Floor material -urban (n= 183)</b>			
	Piped water connection		
	Yes	No	
Cement	96	70	90.7
tiles	1	0	0.6
Earth	1	15	8.7
<b>Total</b>	<b>98</b>	<b>85</b>	<b>100.0</b>
$\chi^2 = 16.482; df= 2; p= 0.000$			
<b>Floor material peri-urban (n=48)</b>			
	Piped water connection		
	Yes	No	
Cement	0	16	33.3
Earth	0	32	66.7
<b>Total</b>	<b>0</b>	<b>48</b>	<b>100.0</b>

#### 4.1.5.3 Source of energy for domestic use

The study found that 49.5% of the 183 households in the urban settlements used electricity for lighting while 100% households in the peri-urban areas used kerosene as the source of light at night. The main source of energy for cooking and boiling water was charcoal and firewood. Of the 183 households in urban areas, 93.5% used charcoal and 91.5% of the 48 peri-urban households used firewood. About 1.1% and 0.9% of the households used electricity and gas for domestic purposes respectively. There was no respondent that reported to use solar energy or biogas for either lighting or cooking. The high cost of electricity was the reason for the low rate of electricity use for cooking. Furthermore, 10.8% of the 213 households did not boil drinking water due to inadequate fuel energy. This comprised 3.0% of the urban households and 7.8% of the peri-urban households that

depended on charcoal and firewood respectively. About 6.07 megawatts of the supplied electricity in the City is used mainly for domestic lighting (MCC, 2004). The present findings imply that lack of cheap alternative source of energy could be a contributing factor for some of the households to use un-boiled drinking water.

#### **4.2 Access to water services in the study area**

In the study wards, 8% of the households were located in low, 13% in medium and 28% in high population density areas respectively. About, 53% of the 183 urban households were found in unplanned settlements. Squatter settlements in urban areas were located in the hilly areas and had high congestion of buildings without adequate piped water network and other social facilities (Figure 4)

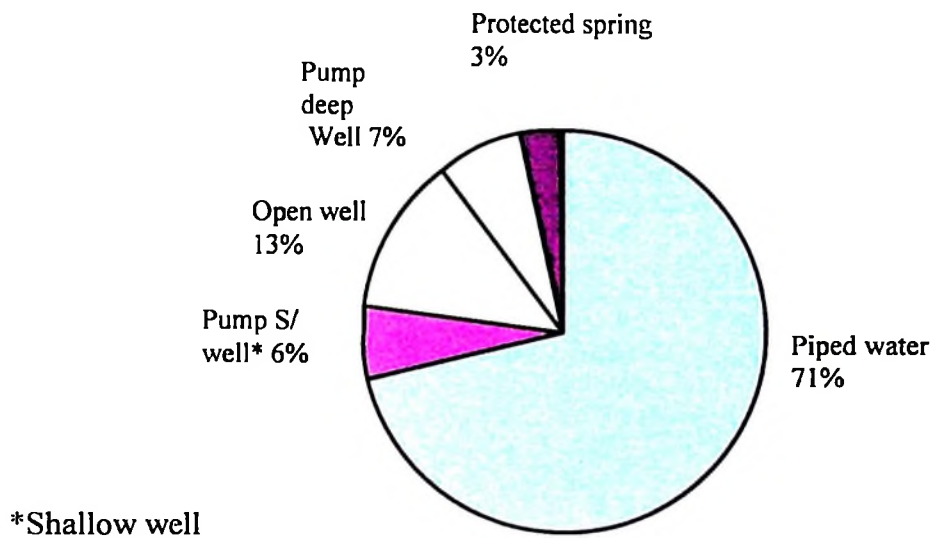


**Figure 4: A squatter settlement at Bugando Mission Street on the rocky hillside of Mwanza City**

#### 4.2.1 Main sources of water for domestic uses

The present study found that 87% of 231 households depended on safe sources of drinking water that included piped water (71% of the households), protected springs (3% of the households), deep and shallow wells (13% of the households) fitted with hand pumps (Figure 5). In Nyamagana district, there were 93.8% of (n=144) households depending on safe sources and for Ilemela district, 95.4% of the 87 households also depended on safe sources of water respectively (Table 7). Overall, piped water abstracted from Lake Victoria was the main source of water for 90.2% of the 183 urban households and for peri-urban areas, shallow and deep wells fitted with hand pumps were the main sources of safe water for 54.2% of the 48 households. The statistical association between the main source of drinking water and household location was highly significant ( $p < 0.001$ ).

The present findings indicate that households in urban areas are more likely to use clean and safe water than the peri-urban households. This implies that household location had an influence on households' access to the main source of drinking water. The 2000 Population and Housing Census (URT, 2004c) reported more or less similar results to the present study, where 97% and 72% of the households in Nyamagana and Ilemela districts respectively depended on piped water, protected springs, deep and shallow wells as their main source of drinking water. It is apparent that the present findings in Mwanza City are above the national safe water coverage in urban areas.



**Figure 5: Main sources of drinking water in the study wards in Mwanza city**

When disaggregated into settlement characteristics, structure and topography, the study found that 54.6% (n=100) urban households from planned areas and 35.6% (n=65) of the urban households from un-planned settlements depended on piped water supply (Table 7). In addition, the study found that households in the hilly urban settlements had a lower rate (23%) of piped water use compared to 59.7% of the 183 urban households from low lying/plain settlements. The findings suggested that, low lying urban residents had better access to piped water services than the residents in the hilly areas. In the peri-urban areas, 68.8% (n= 33) of the households had access to safe sources of drinking water that included hand pump shallow wells, hand pump deep wells and protected springs (Table 7).

**Table 7: Distribution of households by main source of drinking water and location**

Source of drinking water	Household location		
	Urban	Peri-urban)	
Piped water	165	0	
Hand pump shallow well	2	11	
Open shallow well	14	15	
Hand pump deep well	0	16	
Protected spring	2	6	
<b>Total</b>	<b>183</b>	<b>48</b>	
$\chi^2 = 166.621; df=4; p= 0.000$			
Source of drinking water	Settlement characteristic		
	SV	Non SV	PA
Piped	100	65	0
Hand pump shallow well	1	1	11
Open shallow well	7	7	15
Hand pump deep well	0	0	16
Protected spring	1	1	6
<b>Total</b>	<b>109</b>	<b>74</b>	<b>48</b>
$\chi^2 = 167.454; df= 8; p= 0.00$			
Source of drinking water	Topography		
	valley	plain	hilly
Piped water	14	109	42
Hand pump shallow well	0	12	1
Open shallow well	0	24	5
Hand pump deep well	0	14	2
Protected spring	0	7	1
<b>Total</b>	<b>14</b>	<b>166</b>	<b>51</b>
$\chi^2 = 167.454; df= 8; p= 0.00$			
Source of drinking water	District		
	Nyamagana	Ilemela	
Piped water	110	55	
Hand pump shallow well	9	4	
Open shallow well	22	7	
Hand pump deep well	1	15	
Protected spring	2	6	
<b>Total</b>	<b>144</b>	<b>87</b>	

SV= Surveyed; PA= peri-urban

There was a highly significant difference ( $p < 0.001$ ) between main source of drinking water and settlement characteristic and topography suggesting that these factors influenced household access to piped water supply services in the study wards. Access to safe source of drinking water for Mwanza City peri-urban settlements (68.8%) was slightly above the National target of increasing the provision of safe and clean water in the rural areas to 65% by 2009/10 (URT, 2005b).

#### 4.2.2 Alternative sources of water for domestic use

Of the 231 households, 29% reported water from neighbour's tap and only 2.6% reported to use public water tap (Table 8). However, of the 231 respondents, 22.5% of them did not report any alternative water source because of either having adequate water storage facilities or their sources had enough water throughout the year. The findings indicate that households in the urban areas are more likely to have access to clean and safe alternative source of water than those in the peri-urban areas. For example, 95.8% (n= 47) of the 48 peri-urban respondents reported un-protected springs as their alternative source of water compared with 29% of the urban respondents (Table 8).

**Table 8: Alternative sources of drinking water for the study households in Mwanza**

Alternative source	Household location		Percent
	Urban	Peri-urban	
Public tap	6	-	2.6
Neighbour's tap	67	-	29.0
Water vendors	4	-	1.7
Un-protected spring	53	47	43.4
Lake	1	-	0.4
River/streams	1	-	0.4
None	51	1	22.5
<b>Total</b>	<b>183</b>	<b>48</b>	<b>100.0</b>

#### 4.2.3 Household water use pattern

##### 4.2.3.1 Distance to water sources

During the study, respondents were asked on the distance to the nearest source of drinking water. Of the 231 households, 77.9% of them obtained water from sources located within 400 m. These comprised 90.7% (n=183) of the urban households and 29.2% (n= 48) of the

peri-urban households, respectively (Table 9). Furthermore, 58.9% (n = 106) of the 180 households that obtained drinking water within or less than 400 m were located in the surveyed settlements and 33.3% (n = 60) households were located in unplanned urban settlements (Table 9). Only 5.2% of the households in the study wards obtained drinking water from the sources located 1000m or more. The statistical association between distance to the water source and settlement characteristic was highly significant ( $p < 0.001$ ). The results showed that in the study wards, residents from households in planned settlements walked shorter distances to the water sources than those from un-planned settlements.

Of the 48 peri-urban households, 25% obtained drinking water from source located 1000 meters or more. No household in the urban settlements obtained drinking water from sources located more 1000 metres suggesting that peri-urban households covered longer distance to the water source than households in the urban areas. The statistical association between the distance to the source and household location was highly significant ( $p < 0.001$ ). This implies that water availability in urban settlements was much better than in peri-urban settlements.

Table 9: Distance to the nearest water source in the study wards in Mwanza City

Distance to water source (metres)	Household location (n= 231)		Percent
	Urban	Peri-urban	
≥400	166	14	77.9
401- 600	13	14	11.7
601- 800	3	5	3.5
801- 1000	1	3	1.7
1000+	0	12	5.2
Total	183	48	100.0

$\chi^2 = 95.67$ ; df = 4; p = 0.000

Distance to water source (Metres)	Settlement topography			Percent
	Valley	Plain low lying	Hilly	
≥400	14	129	37	77.9
401- 600	0	18	9	11.7
601- 800	0	3	5	3.5
801- 1000	0	4	0	1.7
1000+	0	12	0	5.2
Total	14	166	51	100.0

$\chi^2 = 18.338$ ; df = 8; p = 0.019

Distance to water source (Metres)	Settlement characteristics			Percent
	Surveyed	Not surveyed	Peri-urban	
≥400	106	60	14	77.9
401-600	3	10	14	11.7
601-800	0	3	5	3.5
801-1000	0	1	3	1.7
1000+	0	0	12	5.2
Total	109	74	48	100.0

$\chi^2 = 104.075$ ; df = 8; p = 0.000

Also, respondents were asked on the number of trips covered to collect adequate water for daily requirements. About 20 litres of water or one bucket full of water was collected per trip. Of the 133 respondents from households without piped water connection, 59 (44.4%) respondents reported to collect water 5-6 times per day (Table 10). There was a significant statistical association ( $p < 0.01$ ) between the distance to the source and the number of trips for water collection implying that in the study wards, households close to the water sources collected more water for domestic use than those located far away from the source.

Distance to the water source is influence the per capita water consumption hence the number of water fetching trips among non-piped households. Likewise, family size, availability of storage utensils, numbers of water collectors and topography also has an influence on the amount of household water consumption (IIED, 2003). The present findings are similar to those reported in other urban areas in Tanzania where the daily per capita water use among un-piped households was found to be higher in households close to the water sources than those households far from the sources (IIED, 2003).

**Table 10: Number of water collection trips covered in the study wards in Mwanza City**

Distance to the nearest water source (metres)	Number of water fetching trips				Percent
	2-4 trips	5-6 trips	7-8 trips	9-10 trips	
≥400	22	43	12	3	61.5
401-600	10	13	3	0	20.0
601-800	6	2	0	0	6.2
801-1000	4	0	0	0	3.1
1000+	11	1	0	0	9.2
<b>Total</b>	<b>53</b>	<b>59</b>	<b>15</b>	<b>3</b>	<b>100.0</b>

Number of water fetching trips	Settlement characteristics			Percent
	Valley	Low	Hilly	
2-4 trips	2	38	13	40.8
5-6 trips	1	40	18	45.4
7-8 trips	1	10	4	11.5
9-10 trips	0	2	1	2.3
<b>Total</b>	<b>4</b>	<b>90</b>	<b>36</b>	<b>100.0</b>

$\chi^2=1.652$ ; df=6; p= 0.949

More than forty percent (45.4%) of the 130 households reported to collect water 5-6 trips per day and 40.8% of the 130 households collected water 2-4 times per day (Table 10). On the likelihood that topography and settlement structure could have an influence on access to water services in the study wards, the results showed that 67.8 % (n = 40) of the 59 households that collected water 5 to 6 times daily had their residences located in low

lying/plain areas compared to 30.5% and 1.7% households that were located in hilly and valley settlements respectively (Table 10). The result in Table 10 indicates that the number of water fetching trips decreased as the distance to the water source increased. However, there was no significant statistical difference ( $p>0.01$ ) between topography and water fetching trips. These results suggest that in the study areas, topography did not influence the water fetching trips from the nearest source.

#### **4.2.3.2 Time taken to the water source**

The time taken to reach the water source is critical taking into consideration the household location and natural topographical variation of the study wards. Of the 231 respondents, 72.3% of them reported to walk less than 10 minutes (Table 11) and this comprised 84.2% of the urban households and 27.0% of the peri-urban households. Of the 183 urban households, 24.2% ( $n=56$ ) of them spent 10-30 minutes to collect water from the source. Only 0.9% of the households spent 51-60 minutes to collect water, all of them from the peri-urban areas (Table 11). Referring to 10 minutes as the average time taken to walk 400 m (URT, 2003b), urban households takes less time to reach the water source than the peri-urban households.

At national level, 78% of the urban households walk for 10 minutes or less to reach the nearest water source (URT, 2003b). The statistical association between the time for water collection and household location was highly significant ( $p<0.001$ ) suggesting that water collection was influenced by household location where urban households spent less time to collect water than the peri-urban households. Comparing the study findings and the national data, the present study showed that the proportion of urban households that took

less than 10 minutes time to walk to the nearest source was higher (84.2%) for study wards than the national average (78%) (URT, 2003b).

The increase in the piped water network in the urban areas from 162.3 km in 1996/97 to 209.9 km in 2003/04 coupled with the increase in the proportion of urban households that took less than 10 minutes to collect water from the source could be the reasons for the decrease in the proportion of households that took 10 to 30 minutes to collect water from the source in Mwanza City.

**Table 11: Time taken to the water source in the study wards in Mwanza City**

Water collection time (minutes)	Household location		Percent
	Urban	Peri-urban	
>10	154	13	72.3
10-30	28	28	24.2
31-40	0	2	0.9
41-50	1	3	1.7
51-60	0	2	0.9
<b>Total</b>	<b>183</b>	<b>48</b>	<b>100.0</b>

$\chi^2 = 68.572$ ;  $df = 4$ ;  $p = 0.000$

#### 4.2.3.3 Time spent at the water source

Respondents were asked whether they queued at the source or not and the reasons for queuing. Of the 231 respondents, 32% ( $n = 74$ ) reported to queue at the source. Majority of them (54.1%) reported to queue at the water source for 10-20 minutes (Table 12) and (Figure 6). Of those who spent 10-20 minutes at the source, 55% ( $n = 22$ ) of them were from the peri-urban areas.

**Table 12: Queuing time at the water source in the study wards in Mwanza City**

Queuing time (minutes)	Household location (n=74)		Percent
	Urban	Peri-urban	
≥10	17	12	39.1
10-20	18	22	54.1
21-30	2	2	5.4
41-50	0	1	1.4
<b>Total</b>	<b>37</b>	<b>37</b>	<b>100.0</b>
Critical time for queuing	Household location		Percent
	Urban	Peri-urban	
Morning 0700- 1100 a.m	32	29	82.4
Afternoon 1300- 1400 p.m	1	0	1.4
Evening 1500 - 1800 p.m	1	6	9.4
Throughout the day	3	2	6.8
<b>Total</b>	<b>37</b>	<b>37</b>	<b>100.0</b>

Disparity existed between urban and peri-urban areas on time taken to queue at the water sources with 52.6% of the 37 urban respondents reporting to queue at the source for 10 to 30 minutes. For the peri-urban areas, 64.9% (n=37) of the respondents reported to queue at the source for 10 to 30 minutes. This showed that a higher proportion of peri-urban respondents queued at the water source than urban respondents. Collapse of some of the shallow wells and deep wells fitted with hand pumps and the low water table level during dry season causing low or no water discharge could be the possible explanation for higher number of households that queued at the water sources in the peri-urban areas.



**Figure 6: Queuing for water at a protected spring in Nyakato ward in Mwanza City**

In the peri-urban areas, queuing at the water source was evident at Fumagila village where only two hand pumps were operating. There was slow water discharge at the two water sources caused by prolonged drought in the 2004/05 period. One hand pump was stolen and this caused a long queue at the other two sources as many water collectors came from all the five sub-villages. Due to low water discharge, the local leaders initiated water rationing schedule where water collection was done in the morning and evening to allow water recharge. At Kahama village, the same phenomenon was observed; one shallow well was closed due to lack of water. As for Fumagila village, water rationing at Kahama village was done for almost all the deep wells due to falling water level, prompting some of the residents to collect water from distant sources like unprotected springs, ponds and streams located far from the residential areas.



**Figure 7: Boys and girls washing and collecting water from a stream in Nyakato ward, Mwanza City.**

The World Bank (1997), Kusiluka *et al.* (2004) and Madulu (2000) reported similar situation in other parts of Tanzania on how seasonality affected water availability in rural areas during the dry season. In the dry season, communities are forced to use wells, ponds, streams, and rivers as alternative sources of drinking water (Figure 7 and 8). Also, the falling water tables for most of the natural and man made water sources during dry season made rural people to walk long distances to reach the water sources.



**Figure 8: Boys and girls collecting water from an un-protected spring in Mahina ward, Mwanza City.**

The critical time for queuing was the dry season where 98.6% respondents reported to queue compared to only 1.4% of the respondents that reported to queue during the rainy season. Majority (82.4%) of the respondents reported the critical time for queuing at the source to be 0700- 1100 in the morning (Table 12). Of the respondents that reported to queue at the water source during dry season, 67.6% did so because there were too many people collecting water; 31.1% due to low water volume discharge and only 1.4% due to intermittent water flow.

#### **4.2.3.4 Water collection responsibility**

In the study wards, 46% of the 231 respondents reported women and girls to be involved in water fetching for domestic use, comprising of 43.7% (n= 80) of the urban households and 54.2% (n=26) of the peri-urban households (Table 13). Overall, 71.4% (n =165) of the

respondents reported women, girls and boys to be involved in water fetching for domestic use.

**Table 13: Water collection responsibilities in the study wards in Mwanza City**

Water collection responsibility	Household location		Percent
	Urban	Peri-urban	
Women	8	2	4.3
Men	1	0	0.4
Boys	1	0	0.4
Girls	2	6	3.5
Women and Men	10	5	6.5
Women and girls	80	26	46.0
Women , girls and boys	32	8	17.3
All	49	0	21.2
Others- vendors	0	1	0.4
<b>Total</b>	<b>183</b>	<b>48</b>	<b>100.0</b>

Gender disparities related to fetching water existed between urban and peri-urban settlements. Of the 183 respondents, 43.7% reported Women and girls were involved in water fetching in the urban areas and, for the peri-urban areas, 54.2% of 48 respondents reported Women and girls to be responsible for water collection for domestic use (Table 13).

Various reports indicate that women assisted by girls spend more of their times in water fetching and other related domestic activities than men in Tanzania (World Bank, 1997; Rugumamu, 1999). Men get involved in fetching water only when there are difficulties in obtaining water. In the study areas, the high level of education among household heads in urban areas, possession of piped water connections coupled with the increased gender equality sensitization in Tanzania in recent years, may possibly explain the gender disparity between urban and peri-urban areas.

A visit to Capri-point D Street in Nyamagana wards, a hilly squatter settlement occupied by many poor households bordering the well-off residential houses. In this area, there was serious shortage of piped water supply due to lack of piped water distribution main in the area. Women, young girls and boys from poor households spent most of their time looking for free piped water from their well-off neighbours with private water pumps. The well-off residential houses were enclosed with strong fences and guarded by security guards, who were not allowed to provide water to their neighbours but did so at their own risk.

One female respondent reported that her husband who worked as a security guard in one of the businessperson premises was terminated from job because of providing water to his family and neighbours. Another female respondent reported that she had a serious conflict with her husband, a security guard in one of well-off people residences after she found that her husband had relation with another woman whom she provided free water for a sexual favour. A local leader in the area reported that in March 2005, a seven years old boy died in Lake Victoria after he was caught by a crocodile while collecting water for washing his school uniform. The local leader reported that there were a number of cases that were brought to his attention that involved some primary school girls absconding schools due to pregnancies and conflicts among married couples that were associated with lack of piped water in the areas. It is apparent that involvement of women, young girls and boys in water fetching activities has a significant effect on their socio-economic performances; reduces women's time spent for other productive activities; result into arriving late at work places, and for school age children arriving late or missing class sessions. Furthermore, water inadequacy may trigger domestic violence and social conflicts and exposes men and women to the risks of sexually transmitted diseases including HIV/AIDS.

#### 4.2.3.5 Cost of water services

During the present study, two issues were considered in assessing whether the Mwanza City Water and Sewerage Authority met its obligation of servicing the poor in its area of jurisdiction. The first issue was the cost of water in households with piped water connection (metered or flat rate) and, the second issue was the cost of water among households without piped water connection in their homes or yards. Table 14, presents the household water bills for one or two months prior to the study.

**Table 14: Water bill distribution by household head occupation in Mwanza City**

Monthly water bill (TAS)	Household head occupation –urban areas (n=183)					Percent
	Agriculture	Employed	Registered business	Petty business	Retired officer	
>5,000.00	0	3	3	0	3	4.9
5,000.00 - 8,000.00	3	14	12	1	1	16.9
8,001.00- 11,000.00	0	6	13	0	1	10.9
11,001.00- 14,000.00	1	7	5	0	0	7.2
14,001.00- 17,000.00	0	2	3	0	1	3.3
17,001.00- 20,000.00	0	2	3	0	0	2.7
20,000.00+	0	4	5	0	0	4.9
Don't know	0	13	3	0	0	8.7
Neighbours' tap	8	21	2	35	1	36.6
Private water pump	0	0	1	0	0	0.6
Public tap	0	2	0	4	0	3.3
<b>Total</b>	<b>12</b>	<b>74</b>	<b>50</b>	<b>40</b>	<b>7</b>	<b>100.00</b>

For households without piped water connection in their homes in urban areas, the only dependable source of piped water supply was from the neighbours' water taps and water public tap. Of the 183 urban households, 36.6% and 3.3% depended on neighbours' tap and public tap respectively and less than one percent (0.6%) households had private water pumps. Among the 183 the urban households, 16.9% of them (n= 31) reported to pay TAS 5,000.00 to 8,000.00 per month (Table 14). Less than ten percent (4.9%) of the 183 respondents reported to pay less than TAS 5,000.00. Since the household heads or their

spouses kept the water bill invoices, some of respondents (8.7%) did not know the actual amount on the bills. Included in this group were daughters, sons and house servants (Table 14).

The cost of 20 litres of water from neighbours tap ranged between TAS 10.00 and 30.00. In the study wards, only 29.9% reported to obtained water free of charge from their neighbours (Table 15). In the urban areas, 2.2% (n= 4) of the respondents reported to obtain water from water vendors (Table 8) at a cost of between TAS 45.00 and 50.00 per 20 litres of water. Virtually, in the peri-urban settlements, drinking water was obtained free of charge (Table 15).

**Table 15: Cost of water from public tap/ neighbours tap or shallow well in Mwanza City**

Cost of water (TAS)	Urban	Peri-urban	Percent
10.00 - 20.00	49	0	21.2
25.00 - 30.00	14	1	6.5
Obtained free	22	47	29.9
Not applicable (piped)	98	0	42.4
<b>Total</b>	<b>183</b>	<b>48</b>	<b>100.0</b>

Respondents were also asked on the reason(s) for not having piped water connection. There were only 93 urban households without piped water in their homes, of whom 21 households had piped water supply disconnected. Of the 93 respondents, 41.9% of them could not afford installation costs and this comprised about 70.0% households from hilly settlements that accommodated most of the poor urban squatters (Table 16). About 9.7% (comprising 77.8% respondents from hilly settlements) reported that there were no nearby

main distribution lines and 22.6% reported that they were disconnected because of failure to pay water bills.

**Table 16: Reasons for not connecting to the public piped water system in Mwanza City**

Reason for not having piped water (n=93)	Settlement topography			Percent
	Valley	Plain	Hilly	
<b>Urban (n = 93)</b>				
Can't afford installation costs	3	16	20	41.9
Have own well	0	3	0	3.2
No distribution main	0	2	7	9.7
Disconnected	1	19	1	22.6
No reason	0	7	1	8.6
Rented house	2	9	2	14.0
<b>Total</b>	<b>6</b>	<b>56</b>	<b>31</b>	<b>100.0</b>

The cost of piped water in Mwanza City for one unit of water was (1.0 m<sup>3</sup> or 1000 litres, equivalent to 5 buckets of 20 litre of water capacity) TAS 350.00 (MWAUWASA, 2004). The same amount of water costs about TAS 1000.00 at a rate of TAS 20.00 per 20 liter container among households without piped water supply in their homes. It is clear that households without water connection paid more (about TAS 650.00 extra) than households with water connection. This indicates that households with piped water earned enough revenue by selling tap water to their neighbours to pay their monthly water bill invoices and remained with substantial amount of money to cover for other household expenses. It is documented that for non-piped water sources such as shallow and deep wells, and protected springs, households contribute monthly fee or annual flat fee costs of around TAS 0.05 a litre (URT, 2003b). With piped water costing TAS 20.00 per 20 litre bucket equivalent to TAS 1.00 per litre, it is evident that free water from protected or un-

protected sources remains the only dependable water sources for domestic uses among poor households in the study wards.

Ensuring that every household has access to water by having piped water supply connected to the homestead or water obtained from a public tap could reduce the number of households depending on neighbours water taps. Of the 165 urban households that had access to piped water, 98 (59.4%) of them had pipe water connection (Table 7) and the remaining 67 households depended on neighbours water tap as their main source of domestic water, which represented 40.6% of the 165 urban households.

The fact that, the distance from the water distribution lines and the settlement topography in the study areas varies considerably, the MWAUWASA policy that requires water subscribers to bear all the piped water installation costs is prohibitive to the low income residents who cannot afford the high costs of piped water installation. The policy promotes low-income households to depend on piped water from their wealthy neighbours. Furthermore, the MWAUWASA policy is against the National Water Policy that requires the Urban Water and Sewerage Authorities to provide low-income households with basic level of water supply and sanitation services by putting into place sustainable mechanisms for water supply services at affordable costs to the urban poor (URT, 2002a).

#### **4.2.3.6 Peoples' perception on water services availability**

Of the 231 respondents, 57.6% (n=133) reported water to be 'readily available' and 11.3% (n= 26) respondents reported water to be 'problematic.' Among the 133 respondents that reported water to be easily available, 88.7% (n = 118) obtained water within or less than 400 m and 26.9% (n =7) of the 26 respondents that reported water availability to be

problematic obtained water within a distance of 1000 m or more (Table 17). The statistical association between the respondents' views on water availability and the distance to the nearest water source in the study wards was highly significant ( $p < 0.001$ ) suggesting that the distance covered to the nearest water source was the factor that influenced peoples' perception on water availability in their respective settlements. Thus households walking long distances to reach the water source were not satisfied with water services available in their respective areas.

Among the 26 households that reported water to be problematic, 96.2% ( $n=25$ ) were from squatter and peri-urban areas (Table 17). There was a highly significant statistical association between settlement structure and respondents' view on water availability ( $p<0.001$ ) suggesting that among City residents, households in planned settlements were better served with piped water supply networks than those in squatter and peri-urban areas. Among the 133 sample households that reported water to be readily available, 78.2% ( $n = 104$ ) were from low lying or plain areas, 8.3% ( $n = 11$ ) were from valley and 13.5% ( $n = 18$ ) from hilly areas (Table 17). There was a highly significant association between respondents' perception on water availability and settlement topography ( $p<0.001$ ) implying that topography influenced drinking water availability in the study wards.

**Table 17: Respondent's view on drinking water availability in Mwanza City**

Household characteristic	View on drinking water availability		
	Readily available	Not easily available	Problematic
Distance to the water source			
≥400	118	55	7
401-600	8	13	6
6001-800	3	1	4
801-1000	2	0	2
1000+	2	3	7
<b>Total</b>	<b>133</b>	<b>72</b>	<b>26</b>
$\chi^2 = 65.745; df = 8; p = 0.000$			
<b>S/ structure</b>			
H/density	45	14	1
M/density	24	7	0
L/density	18	1	0
Squatter/peri-urban	46	50	25
<b>Total</b>	<b>133</b>	<b>72</b>	<b>26</b>
$\chi^2 = 47.93; df = 6; p = 0.000$			
<b>Topography</b>			
Valley	11	3	0
Plain	104	48	14
Hilly	18	21	12
<b>Total</b>	<b>123</b>	<b>72</b>	<b>26</b>
$\chi^2 = 21.84; df = 4; p = 0.000$			

Review of MWAUWASA's documents revealed that the average daily water production capacity in Mwanza City for the year 2003/04 was 42 000 m<sup>3</sup> (80.8%) against the actual water demand of 52 000 m<sup>3</sup>. Also there was high rate (50%) of an unaccounted for water caused by physical leakage, illegal water connections and reconnections, by-passing of water metres, tampering with water metres (MWAUWASA, 2004). Such high rate of unaccounted for water further reduced the amount of water availability in some areas.

Discussion with the MWAUWASA officials and ward executive officers from the study wards revealed the existence of technical and non-technical factors that contributed to inadequate water availability in some areas. The factors included inadequate size of distribution lines and lack of distribution lines in some of the newly surveyed areas,

proliferation of unplanned settlements especially in the hilly areas that made extension and improvement of water and sewerage services difficult and costly (as it required compensation; inadequate water storage facilities and number of booster stations), old and leaking distribution lines and unreliable power supply and falling Lake Victoria water level.

### 4.3 Sanitation services

#### 4.3.1 Ownership of toilet facilities

To estimate the percentage coverage of households with and without access to sanitation, respondents were asked on the ownership of toilet facility. Overall, 3% of the 231 households in the study wards had no toilet facility for waste disposal (Table 18). In the urban areas, only 0.6% of 183 households did not have toilet facilities whereas in the peri-urban areas, 12.5% of the 48 households did not have toilet facility and depended on neighbours' toilet facilities or nearby bush.

**Table 18: Type of toilet facilities in various sites in study wards in Mwanza City**

Type of toilet facility	Settlement topography		Percent
	Urban (n=183)	Peri-urban (n=48)	
Pit latrine	46	38	36.4
Pour flush latrine	52	4	24.2
Flush toilet	84	0	36.4
No toilet facility	1	6	3.0
<b>Total</b>	<b>183</b>	<b>48</b>	<b>100.0</b>

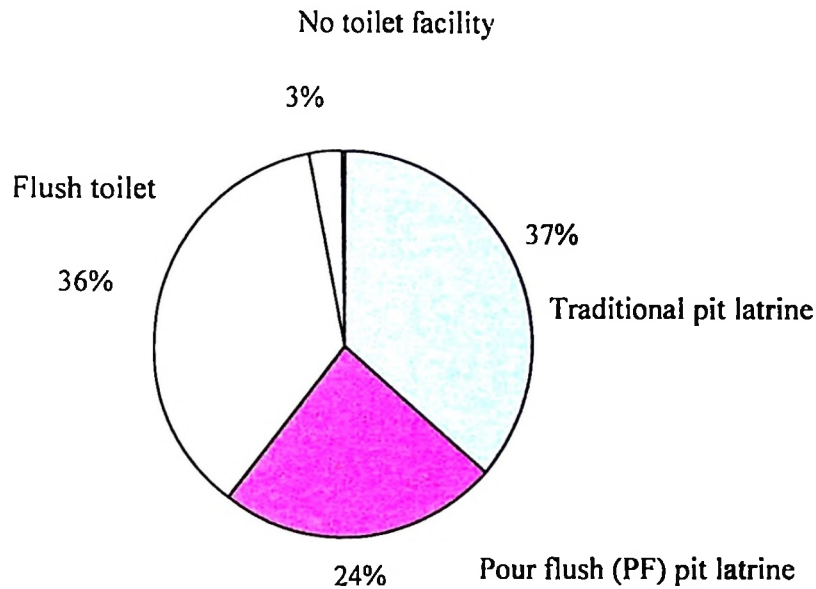
  

Type of toilet facility	Settlement structure				Percent
	High density	Medium	Low density	Unplanned	
Pit latrine	8	2	3	71	36.4
Pour flush latrine	16	7	0	33	24.2
Flush toilet	36	22	16	10	36.4
No toilet facility	0	0	0	7	3.0
<b>Total</b>	<b>60</b>	<b>31</b>	<b>19</b>	<b>121</b>	<b>100.0</b>

The Population and Housing Census 2002 (URT, 2004a) recorded that 2.5% of the households in Mwanza City were without toilet facilities of any kind. The URT (2000) reported more or less similar proportion of households without toilet facility of 2.4% for urban areas and 9.8% for rural areas. Comparing the Population and Housing Census data for Mwanza City and the national survey data for urban and peri-urban areas, the present findings indicate that the proportion of households using toilet facilities decreased from 97.6% in 2000 to 97% in 2005. However, the present study findings indicated that access to sanitation services in Mwanza City was above the national target of 95% for all Tanzanians (URT, 2005b).

#### **4.3.2 Types of toilet facilities**

The traditional pit latrines and pour flush toilets were the commonest toilet facilities for majority (61 %) of the 231 households (Figure 9). Of the 48 households in peri-urban areas, 77.1% used simple pit latrine compared to 25.5% of the urban households that used simple pit latrines. It is possible that the simplicity of operation and construction, low cost of construction materials were among the factors that made pit latrines the most common form of waste disposal available among peri-urban households and low-income households in urban settlements.



**Figure 9: Distribution of toilet facilities in the study areas in Mwanza City**

When well designed, constructed and maintained, the traditional pit latrines provide a standard form of sanitation and hence minimize transmission of diseases associated with indiscriminate human excreta disposal (URT, 1997). Furthermore, a facility for excreta disposal should prevent contamination of surface soil and surface water by run-off or by open defecation or by underground water by seepage (UN-Habitat, 2003). Unfortunately, some ground conditions make it unrealistic to meet such criteria. The hillsides and hilltops in Mwanza City are rocky with large rocks that outcrops on or near surfaces making impractical for most of the poor households to excavate toilet pits to 1.5 to 3.5 metres deep (URT, 1997; CBEM, 1998). The present study revealed that, 38.0% of the 71 urban households (Table 18) in the hilly squatter settlements had pit latrines with shallow pits and that were poorly constructed and maintained.



**Figure 10: A pour flush pit latrine with a collapsed side pit at Isamilo squatter settlement in Mwanza City**

Furthermore, of the 33 households in the hilly squatter urban settlements, 42.4% had pour-flush toilet facilities. Some of the pour flush toilets facilities were found to be poorly constructed and maintained with shallow pits (Figure 10). The side pits had no top covers and hence liable to collapse. The toilet facilities produced unpleasant smell and provided breeding sites for disease vectors such as flies, mosquitoes and cockroaches. Such type of toilet facilities were potential for sources of pathogens for water-borne diseases such typhoid fever and other enteric diseases.

Some of the respondents who were interviewed reported that some households in the hilly squatter settlements in Mbugani and Isamilo wards had plugs fixed on the side of latrines' pits that were usually opened during heavy rains to allow the contents to flow down hill to join river Mirongo that discharges into Lake Victoria. The allegations were supported by a

Tanzania Television (TVT) journalist in Isamilo ward who, using his powerful camera reported to have noticed in March 2005 an unidentified household member during heavy rains emptying a toilet facility using a bucket thereby allowing the excreta flow downhill into the water storm drainage system. A visit to Mwanza South in Mkuyuni ward revealed that constant dumping of domestic and industrial wastewater and solid waste into Mkuyuni-Nyanguganwa stream that resulted into accumulation of silt such that its banks and adjacent plots at the point where it enters Lake Victoria were turned into horticultural units that were irrigated using polluted water from the stream.

The sanitation situation was much better in low density settlements located in hilly and some unplanned areas at Capri-point D Street in Nyamagana ward. Almost 38% of the households owned flush toilet facilities in the surveyed hilly settlements and 3 out of 10 households in unplanned settlements had well designed and constructed septic tanks with sufficient capacity for both retention of liquid waste and storage of sludge and scum. The households' heads in such settlements belonged to the well-off category, some of the houses had piped water supply in their homes from either MWAUWASA or privately owned water pumps that drew water from Lake Victoria.

### **4.3.3 Sanitation and waste disposal**

#### **4.3.3.1 On-site sanitation waste disposal**

Respondents were asked on the methods they employed to empty their toilet facilities. The findings indicate that changing toilet location by constructing new toilet facility was the commonest method. Of the 231 households, 25.5% reported to change toilet location, comprising 54.2% of the 48 peri urban households and 231 of the households, 14.3% reported to hire vacuum emptying facilities (Table 19).

**Table 19: Means of emptying toilet facilities by residence in the study wards in Mwanza City**

Means of emptying septic tank/cesspit (n= 219)	Residence		Percent
	Urban	Peri-urban	
Hiring emptying facilities (vacuum tankers)	33	0	14.3
Hiring individuals	23	1	10.4
Subscribing to sewerage services	12	0	5.2
Changing toilet location	30	29	25.5
Toilet not yet full	84	12	41.6
Not applicable (no toilet facility)	1	6	3.0
<b>Total</b>	<b>183</b>	<b>48</b>	<b>100.0</b>

Manual emptying of pour-flush toilet facilities was a common practice mostly among urban households located in the hilly area. Of the 171 urban households from settlements without the sewerage network 13.5% of them hired individuals to empty their toilet facilities. Of the 48 peri-urban households, only 2.1% of them hired individuals to empty their toilet facilities manually. Discussion with Mwanza City health officer revealed that some building owners failed to hire vacuum tankers for emptying toilet facilities at TAS 15000.00 to 20000.00 per trips. It requires more than one trip to empty a full toilet facility. It is well documented that inadequate drainage and poor waste disposal poses the risk of contamination with water-borne pathogens to both underground and surface water resources (WHO and UNICEF, 2000).

Manual emptying of toilets and shifting latrine pits location poses health risks to the public especially when the sludge is not adequately buried or the abandoned pits are not covered properly. From a public health point of view, manual emptying of pits or changing location in the highly populated urban settlements should be avoided, and the wet sludge removed by vacuum tankers (URT, 1997). It is possible that, manual removal of excreta

contributed to the occurrence of water-borne diseases in the study areas due to contamination of surface and underground water resources.

#### 4.3.3.2 Sewerage waste disposal

In the study wards, only 6.5% of the 183 urban households had their toilet facilities connected to the sewerage systems. Among the study wards, Nyamagana ward had the higher number of households (2.7%) connected to the sewerage system (Table 20). Review of MWAUWASA reports revealed that the sewerage services were available mainly in wards located at the central part of Mwanza City. However, the proportion of households that received sewerage services was very low. According to URT (1997), the proportion of population that received sewerage services were: Pamba (36%), Nyamagana (5%), Mbugani (19%), Isamilo (1%) and Mirongo (42%). The proportion of sewered households at Majengo Mapya in Pasiansi ward could not be established because the sewer system was constructed only recently (2003).

**Table 20: Distribution of households connected to sewerage system in the study wards in Mwanza City**

Name of ward	Number of Hh	Hh connected to sewerage system	Percent
Mahina	23	0	0.0
Nyakato	34	0	0.0
Mbugani	25	3	1.6
Isamilo	23	3	1.6
Pasiansi	29	1	0.6
Nyamagana	26	5	2.7
Mkuyuni	23	0	0.0
<b>Total</b>	<b>183</b>	<b>12</b>	<b>6.5</b>

Hh= households

Comparing the finding of the present study (Table 20) and those reported earlier (URT, 1997) for wards with sewerage services, it is apparent that there is a decrease in the proportion of households subscribing to sewerage services in wards with sewerage

network. This implied under utilization of the sewerage services probably due to low public awareness on sewerage services in their areas. However, more research is needed to establish the actual causal factors.

Discussions with the MWAUWASA network technician and the City Health Officer revealed that topography limited the extension of the existing sewerage system to some areas not only due the difficulties in sewerage system construction but also because it would need pumping system to move wastewater uphill before getting to the treatment ponds. Of the 231 households, 25.5% (n=59) of them reported to change toilet location. Furthermore, emptying toilet facilities using vacuum tankers was possible only in surveyed and accessible settlements. Of the 231 households, 14.3% of them hired vacuum tankers for emptying their toilet facilities comprising 87.9% from surveyed and 84.8% from low lying settlements (Table 21).

**Table 21: Means of emptying toilet facilities by settlement characteristics and settlement topography in the study wards in Mwanza City**

Means of emptying toilet facility	Settlement characteristic ( n =231)			Percent
	Surveyed	Not surveyed	Peri-urban	
Hiring vacuum tankers	29	4	0	14.3
Connected to sewerage system	12	0	0	5.2
Hiring individuals	9	14	1	10.4
Changing location	7	23	29	25.5
Toilet not yet full	52	32	12	41.6
Not applicable	0	1	6	3.0
<b>Total</b>	<b>109</b>	<b>74</b>	<b>48</b>	<b>100.0</b>
Means of emptying toilet facility	Settlement topography ( n =231)			Percent
	Valley	Plain	Hilly	
Hiring vacuum tankers	1	28	4	14.3
Connected to sewerage system	1	11	0	5.2
Hiring individuals	7	8	9	10.4
Changing location	0	41	18	25.5
Toilet not yet full	5	73	18	41.6
Not applicable	0	5	2	3.0
<b>Total</b>	<b>14</b>	<b>166</b>	<b>51</b>	<b>100.0</b>

#### 4.4 Sanitation and water-borne infections

As indicated earlier, Mwanza City residents depend on surface and underground water resources distributed through piped water system or obtained from shallow wells with or without water pumps or deep wells fitted with pumps. However, environmental contamination caused by improper liquid and solid waste disposal in urban settlements has rendered water from lakes, streams, ponds, springs and underground unsafe for domestic use without further treatment (CBEM, 1998). Thus, piped water supply after treatment is the only safe source of water for domestic uses in urban areas. For the peri-urban settlement, protected springs, hand pump shallow wells and deep wells are the dependable sources of potable water for domestic uses (URT, 2003b).

##### 4.4.1 Knowledge on water-borne diseases

Of the respondents from urban areas 87.9% (n=161) and for the peri-urban 81.3 % (n=39) of them were aware of health problems caused by improper disposal of human excreta. Diseases like helminthosis, gastro-enteritis, typhoid fever, amoebic dysentery, schistosomosis, respiratory and skin infections were mentioned by respondents as the health risks associated with improper disposal of human excreta (Table 22).

**Table 22: Respondent's knowledge on the public health problems associated with improper disposal of human excreta in the study wards in Mwanza City**

Health problem	Urban	Peri-urban	Percent
Helminthosis	11	6	7.4
Gastro-enteritis	6	7	5.6
Typhoid fever	27	1	12.1
Amoebic dysentery	8	0	3.5
Skin infection in children	1	3	1.7
Schistosomosis	5	1	2.6
Respiratory infections	1	0	0.4
No infection	124	30	66.7
<b>Total</b>	<b>183</b>	<b>48</b>	<b>100.0</b>

According to the Mwanza City Council profile (2004), gastro-enteritis, dysentery, typhoid fever and schistosomosis are the leading water-borne diseases. Discussion with the City Health Officer revealed that the City Council had initiated an extensive programme on public awareness creation coupled with community involvement in the prevention and control of water-borne diseases. The programme's strategies involved educating the communities in the urban and peri-urban areas on the importance of constructing and use of toilets; chemical treatment and or boiling water for domestic use; improvement of onsite sanitation; community involvement on sustainable management and disposal of solid wastes; improvement of sewerage and wastewater treatment systems; and reinforcement of environmental sanitation by-laws. The City Council's strategies for the control and prevention of water-borne diseases could explain the insignificant difference in respondents' knowledge of health problems due to improper disposal of human excreta in the study wards.

#### **4.4.2 Occurrence of water-borne diseases**

##### **4.4.2.1 Typhoid and gastro-enteritis**

Adequate sanitation at household and community level minimizes the prevalence of water and sanitation-related diseases (URT, 2003b). Respondents were asked on the occurrence of water-borne diseases and whether they boiled drinking water or not. Among the 183 urban respondents, 67.8% reported no cases of water-borne infections in their homes. Likewise, 62.5% of the 48 peri-urban reported no cases of water-borne infections in homes. However, typhoid fever was the leading water-borne disease where 14.8% of the 183 urban respondents reported to have experienced typhoid fever in their homes six months prior to the study (Table 23).

**Table 23: Occurrence of water-borne diseases in relation to water treatment by boiling in Mwanza City**

Type of health problem	Boiling drinking water		Percent
	Yes	No	
<b>Urban (n=183)</b>			
Helminthosis	8	3	6.0
Gastro-enteritis	6	0	3.3
Typhoid fever	26	1	14.8
Amoebic dysentery	6	2	4.4
Skin infection in children	1	0	0.6
Schistosomosis	4	1	2.5
Coughing	1	0	0.6
No infection	111	13	67.8
<b>Total</b>	<b>163</b>	<b>20</b>	<b>100.0</b>
<b>Peri-urban (n=48)</b>			
	Boiling drinking water		Percent
	Yes	No	
Helminthosis	3	3	12.5
Gastro-enteritis	1	6	14.5
Typhoid fever	0	1	2.1
Skin infection in children	0	3	6.3
Schistosomosis	1	0	2.1
No infection	7	23	62.5
<b>Total</b>	<b>12</b>	<b>36</b>	<b>100.0</b>

$$\chi^2 = 7.523; df = 7; p = 0.377$$

In the peri-urban areas, gastro-enteritis was the leading water-borne condition where 14.6% (n=48) of the respondents reported to experience gastro-enteritis in their homes. The study also revealed that 82.5% (n=183) of the urban respondents reported to wash hands with soap after visiting the toilet compared to 18.8% (n= 48) of the peri-urban respondents. Of the 231 households, 12.1% reported to wash clothes and utensils at the water sources and 2.6% of them took bath at the water source.

Although boiling of drinking water significantly reduce the water-borne diseases causing pathogens, the study found that 15.9% of the urban households that routinely boiled water reported to experience typhoid fever within six months before the study (Table 24).

Routine household cleanliness and hygienic handling of treated water is an effective method of controlling water-borne diseases. The manner in which water is handled and stored could be a potential source of potable water contamination in the household that deserves attention. There was no significant statistical association ( $p > 0.05$ ) between occurrence of typhoid fever and boiling of drinking water, implying that boiling did not reduce significantly the incidences of disease in the study wards. It is possible that, failure to wash hands with soap after visiting toilets, poor handling of boiled drinking water, use of contaminated water from streams for washing food and utensils, eating inadequately cooked vegetables (salads) and unwashed fruits could be responsible for the occurrence of typhoid fever and gastro-enteritis in Mwanza City.

Studies conducted by Mnyanga and Semili (2001) found a significant number of faecal coliforms ( $4 \cdot 10^6$  colony forming units/ 100 ml) in water samples taken from upstream and downstream at the point where the River Mirongo and the Lake Victoria meet. The faecal coliforms indicate faecal contamination of water sources and in many cases are accompanied by pathogenic organisms causing diseases such as typhoid fever (Mitchell and Stapp, 1993). The high number of faecal coliforms observed in water sampled along Mirongo River and Lake Victoria suggests domestic wastewater discharge into the environment including rivers and could be responsible for the occurrence of water-borne diseases in Mwanza City.

Secondary data on the occurrence of gastro-enteritis in peri-urban areas obtained from disease records at Kahama village dispensary in Ilemela peri-urban area revealed that 76% of 171 infants below the age of five years and 62% of 153 adult patients were gastro-

enteritis cases. Due to lack of diagnostic facilities in the peri-urban health facilities, there were no records of typhoid fever at Kahama village dispensary (Table 24).

**Table 24: Number of water-borne disease cases at Kahama dispensary in Ilemela ward in Mwanza City from January 2005 to September 2005**

Cases in children below 5 years			Cases in children 5 years or more		
Infection	Frequency	Percent	Infection	Frequency	Percent
Helminthosis	20	16.7	Helminthosis	46	30.1
Gastro-enteritis	130	76	Gastro-enteritis	95	62.1
Dysentery	21	12.3	Dysentery	12	7.8
Total	171	100.0	Total	153	100.0

Source: Kahama village dispensary, 2005

The diseases records at Kahama village dispensary supported the present findings on the occurrences of water-borne diseases in Mwanza City.

#### 4.4.2.2 Gastro-enteritis in children under five years of age

Gastro-enteritis is among the major causes of morbidity and mortality in children under five years in Tanzania, and it is considered to be a result of drinking contaminated water and unhygienic practices of handling food and preparation (URT, 2003c; URT, 2005b). To verify on the occurrence of gastro-enteritis in children under five years of age, respondents were asked whether any of their children under five years of age have had gastro-enteritis within the past two-month's period preceding the study. About 7.4% (n = 17) of the 231 respondents reported their under five children to had suffered from gastro-enteritis prior to the study (Table 25). Of the 17 households that reported gastro-enteritis, 70.6 % (n =12) of the depended on agriculture as their main source of livelihood. Further more, 53% (n=9)

of the 17 households that reported to experienced gastro-enteritis in children below five years of age were from households without formal education. The statistical association between the occurrence of gastro-enteritis, the occupation and education level of the household head was highly significant ( $p < 0.000$ ) suggesting that the household's head occupation and education level influenced the occurrence of gastro-enteritis in children in the study households. Furthermore, the study found that 88.2% of the 17 households that reported gastro-enteritis in children below the age of five years were from male headed households. However, the statistical association between the sex of the household head and the occurrence of gastro-enteritis in under five years children was not significant ( $p > 0.01$ ) implying that the sex of the household head did not influence the occurrences of gastro-enteritis in under five years children in Mwanza City.

The Tanzania Reproductive and Child Health Survey (TRCHS) reported that children at the age of six to twenty four months, with the highest risk being between 6-12 months of age are at higher risk to gastro-enteritis because at this age children start to crawl and eat water diluted supplementary foods (URT, 1999). Furthermore, demographic and health survey indicates a strong relation between the poverty status of the household and the occurrence of gastro-enteritis in under five years children with higher prevalence rate among poor families and mothers with low education levels (URT, 2005b). The present study recorded a lower figure for gastro-enteritis cases (7.4%) for children under five years of age than the national 13% prevalence of gastro-enteritis in under five (URT, 2005b) indicating an improvement in the child health in the study wards.

**Table 25: Reports of gastro-enteritis in children of years of age by household head's occupation and educational background in Mwanza City**

Household head's occupation	Gastro-enteritis occurrences		Percent
	Yes	No	
Agriculture	12	40	22.5
Employee	2	75	33.3
Registered business	1	56	24.7
Petty business	0	26	11.3
Retired employee	2	13	6.5
Others	0	4	1.7
<b>Total</b>	<b>17</b>	<b>214</b>	<b>100.0</b>

$\chi^2 = 27.198$ ;  $df = 5$ ;  $p = 0.000$

Household head's education level	Gastro-enteritis occurrences		Percent
	Yes	No	
No formal education	9	21	13.0
Primary school education	6	122	55.4
Secondary school education	1	26	11.7
Post secondary school education	1	45	19.9
<b>Total</b>	<b>17</b>	<b>214</b>	<b>100.0</b>

$\chi^2 = 26.24$ ;  $df = 3$ ;  $p = 0.000$

#### 4.5 Maintenance and management of water sources

##### 4.5.1 Water sources conservation in the peri-urban settlements

To assess the local communities' involvement in the conservation of water resources in their areas, respondents were asked on their roles as far as maintenance and management of the water resources were concerned. Of the 231 respondents 27.2% reported that "community members" were responsible for the maintenance of water sources comprising 76.2% (n=48) peri-urban households. About 72% households reported that owner of the water sources were responsible their maintenance. The rate of labour and money contribution towards maintenance and management of water resources was higher in the peri-urban areas because 96% (n=24) of the 25 respondents reported to contribute money in form of WUGAs toward maintenance and management of the water resources (Table 26).

**Table 26: Water sources maintenance and conservation in Mwanza City**

Water maintenance responsibility	Household location		Percent
	Urban	Peri-urban	
Community members	15	48	27.2
Owner	166	0	71.9
Others	1	0	0.04
Agent	1	0	0.04
<b>Total</b>	<b>183</b>	<b>48</b>	<b>100.0</b>
Resources for water sources maintenance	Urban	Peri-urban	
WUGAs Fund	1	24	10.8
Government fund	2	0	0.9
Community labour contribution	8	20	12.1
Community money contribution	3	4	3.0
Owner	169	0	73.2
<b>Total</b>	<b>183</b>	<b>48</b>	<b>100.0</b>

Availability of safe and clean water is strongly linked to the healthy environment from which water is abstracted and made available to the people. Furthermore, human activities and uncontrolled water abstraction is responsible for deterioration of water in terms of quality and quantity with great impact on the available water resources (Maganga *et al.*, 2001). Availability of safe and clean water is strongly linked to the healthy environment from which water is abstracted and made available to the people. Discussion with the local leaders at Kahama and Fumagila villages revealed that the shallow wells and deep wells fitted with hand pumps were constructed by the villagers with the support from the Health through Sanitation and Water (HESAWA) programme. Initially, the villagers' contribution was through labour in the form of site clearing, collection of stones and sand plus digging of the pits for installation of the pumps. After installation of pumps, Water Users Group Associations (WUGAs) were formed and each household paid registration and membership fees. The fees ranged between TAS 500.00 and TAS 3000.00 depending of the financial position of the household head and the numbers of members using the

shallow or deep well. The WUGAs have the right to own and obligation to keep the water facility clean and protected from theft and damage. Apart from maintenance of shallow and deep wells; communities participate in the management of natural springs and open shallow wells in their localities (Figure 11). This was in the form of labour contribution through constructing fences and clearing bush around the sources.



**Figure 11: A deep well at Kahama village in Mwanza City.**

Communities also contributed money for purchasing materials needed for improving the sources like cement and pipes and paying allowances for people who volunteered to guard the sources. The findings of the present study are similar to those of Dungumaro and Madulu (2002) who reported that the maintenance and management of water resources in the urban areas involved the protection of natural springs and shallow wells by planting trees and prohibition of vegetation clearing in water catchments, wetlands and around the

natural water sources, and enactment of by-laws to limit human activities such as bathing and washing clothes close to the drinking water sources.

#### **4.5.2 Water sources conservation in the urban settlements**

In the urban areas, the spirit of maintenance and management of water resources was less cherished because only about 8% of the 183 urban respondents reported to participate in water resources management. Comprehensive management of water resources focusing on communities' empowerment to initiate, own and manage their water sources, pollution control and public health awareness is important to ensure that water resources are used in a sustainable manner (Maganga et al., 2001; URT, 2002a). The findings at Isamilo hilly squatter settlement (Figure 10) of some households that had poorly constructed sometimes leaking pour flush toilets and traditional pit latrines, was a clear indication that in urban areas, residents contribute to water resources pollution by discharging wastewater directly or indirectly into Lake Victoria. Furthermore, the study found that in Mbugani ward, some residential and commercial buildings were built only few metres from river Mirongo where solid and liquid wastes were being dumped directly into the river that flows into Lake Victoria (Figure 12).



**Figure 12: Residential and commercial buildings on River Mirongo banks in Mwanza City. Solid and liquid wastes dumped or discharged into the river pollute the water**

A number of studies reported similar findings regarding water resources pollution in urban areas in Mwanza City where some toilet facilities are constructed deliberately to discharge wastewater into Lake Victoria (CBEM, 1998; Mnyanga and Semili, 2001; Rwabigene, 2002). Also, Machiwa (2002) and Rwabigene (2002) found that clearing of vegetation around water sources in urban areas of Mwanza City is a common phenomenon where lake shores and river banks wetlands are encroached and cleared for residential, hotel, industrial development and for horticultural plots. The continued encroachment of wetlands for residential and industrial development and the indiscriminate wastewater and solid wastes disposal into water sources contribute to pollution of water sources. Furthermore, the proliferation of squatter settlements and stone quarrying on the hill sides and hilltops despite the Mwanza City Master Plan policy requiring the eviction of

squatters in the hilly areas (MCC, 2004) reflects the inadequate measures taken by the MWAUWASA, MCC and the public in general towards integrated water resource management in the City.

## CHAPTER FIVE

### 5.0 CONCLUSION AND RECOMMENDATIONS

#### 5.1 Conclusion

The present study on accessibility and utilization of water and sanitation services in Mwanza City has demonstrated that although there is a significant improvement in the provision of safe drinking water and use of sanitation facilities, there are still a number of households that depend on unsafe sources of drinking water including unprotected springs, rivers, streams and lake. The study has also shown that a number of households in Mwanza City have inadequate access to sanitation facilities. Household location, the increase in unplanned settlements and topography are the main factors contributing to inadequate water and sanitation services in Mwanza City.

The main sources of safe and clean drinking water for urban areas is piped water and for peri-urban households are protected springs, shallow and deep wells fitted with hand pumps. There is a strong relationship between the main source of drinking water and household location justifying the hypothesis that household location has influence on households' access to water services. Lack of piped water supply in peri-urban areas is associated with the Urban Water and Sewage Authorities' policy of providing water and sanitation services only in the urban settlements. Urban residents in low lying settlements receive better piped water services than their counterparts in the hilly settlements due to the difficulty of extending the piped water network to the unplanned hilly settlements.

In urban areas, the presence of piped water network and high number of households with piped water connections makes the residents to walk shorter distances and spend less time

to collect water from the sources than the peri-urban residents. The association between the respondents' views on water availability and the distance to water source was highly significant suggesting that the distance to water source was the factor that influenced peoples' perception on water availability in their respective settlements.

The use of traditional and pour flush pit latrines is common in both urban and peri-urban settlements. The low sewerage network coverage in Mwanza City has resulted in most of the households to opt for on-site sanitation facilities including septic tanks, pour flush and traditional pit latrines. Most households opt for changing pit latrine's location and manual emptying of septic tanks due to failure of some building owners to hire toilet emptying facilities coupled with inaccessibility for some settlements in the urban settlements. The use of unsafe sources of drinking water, failure of some residents to boil drinking water and unhygienic handling of water for domestic use is responsible for the occurrence of water-borne diseases particularly gastro-enteritis and typhoid fever in Mwanza City. Children under five years of age from household heads depending on agriculture as the main occupation and household heads without formal education were more exposed to risk of gastro-enteritis. There is strong association between occupation and education level of the household head, rejecting the null hypothesis that socio-economic factors has no influence on the prevalence of water-borne diseases among City residents. Haphazard disposal of wastewater and inadequate water sources conservation measures are responsible for pollution of water resources in Mwanza City.

## **5.2 Recommendations**

From the present study, the following recommendations are made:

### **5.2.1 The Urban Water and Sanitation Authorities**

- Since low-income people live in underprivileged urban settlements with inadequate water and sanitation services; during extension of the piped water and sewerage networks, the Mwanza Urban Water and Sanitation Authority should give priority to unplanned settlements occupied mostly by low-income residents.
- To avoid the difficulties experienced in constructing piped water networks in unplanned settlements, the water and sanitation utilities should extend water networks to the rapidly growing townships in Mwanza City suburbs such as Kishiri and Busweru in Igoma and Ilemela wards in Mwanza City before such settlements attain a saturation point making it impossible to lay piped water distribution lines. The same should be implemented to planned areas soon after approval of the land use maps.
- The Urban Water and Sanitation Authorities policy of serving only the urban areas should be revised to include the peri-urban areas. For the peri-urban areas where the extension of the piped water supply from the City centre will not be feasible, the water and sanitation utilities should consider the construction of deep and shallow wells fitted with hand pumps or borehole wells. In line with the 2002 National Water Policy, the beneficiaries in the peri-urban areas should be encouraged to manage and run the water schemes in partnership with the private sector for sustainable water service delivery in their area.
- The 2002 National Water Policy stipulates that buildings located within 30 metres from the sewerage line should be connected to the sewerage system. Currently, the available sewerage network in Mwanza City is not fully utilized and therefore, it is

important for the MWAUWASA to mobilize and encourage more house owners in areas where the network is available to subscribe to sewerage services.

### **5.2.2 The Mwanza City Council**

- To ensure adequate and sustainable supply of potable water for domestic use and mitigate the problems of continued water resource pollution from various sources, the City Council should adopt an integrated water conservation programme to be implemented in both the urban and peri-urban areas. The programme should promote conservation of water sources and sanitary water use practices by the local communities so as to raise their awareness on the prevention and control of water-borne diseases and protection of the water sources and infrastructures.
- To control water sources pollution from domestic solid and liquid wastes, construction of any proposed large commercial and residential buildings on river banks and other places near water source should be discouraged and where deemed necessary, such activities should be preceded by an Environmental Impact Assessment (EIA) assented by the relevant authorities. Moreover, the existing and proposed residential and commercial buildings should observe proper sanitary production practices to minimize water resources pollution.
- To ensure adequate coverage cesspit emptying services, the City Council should attract more private sector cesspit emptying service operators. Also, the Council should strengthen its educational campaigns on proper waste disposal and take stringent measures against any individuals or institutions that might fail to comply with the City's legislations and by-laws on proper disposal of solid and liquid wastes.

### 5.2.3 Research and development partners

- In addition to construction of shallow and deep wells fitted with hand pumps for safe domestic water provision in the peri-urban areas, the government and other development partners should allocate resources towards improvement and protection of traditional water sources such as open wells and springs, adoption and use of rain water harvesting technology, particularly in the peri-urban areas and low-income urban households for year round water storage.
- The present study collected information on the number of urban households with access to sewerage services. However, the study did not capture information on the reasons for low rate of subscription to the sewerage services in settlements with the sewerage network. It is recommended that, more research be carried out to establish the reason for low rate of households connection to the sewerage network and whether this correlate well with the socio-economic status of the household.
- More research is needed to establish the causal factors for higher proportion of households being located in the unplanned settlements in Mwanza City and find out if the high urban population is related to the decline of the number of households with access to safe water consumption including drinking and personal hygiene.

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## APPENDICES

## Appendix 1: Questionnaires for household respondents

Date of interview.....District.....  
 Ward.....Street\*/village.....

\* delete accordingly

## 1.0 Socio-demographic characteristics of the household

1.1 Age of respondent .....years

1.2 Sex of respondent

1. Female [ ]    2. Male                    [ ]

1.3 Respondent's family status (relationship with the household head)

- 1. Household head ..... [ ]
- 2. Son..... [ ]
- 3. Daughter..... [ ]
- 4. Spouse (wife)..... [ ]
- 5. Others (specify).....

1.4 Educations level of the household head

- 1. No formal education..... [ ]
- 2. Primary education.....[ ]
- 3. Secondary education..... [ ]
- 4. Post secondary education.....[ ]
- 5. Others (specify).....

1.5 Household's head marital status

- 1. Married..... [ ]
- 2. Single..... [ ]
- 3. Widowed..... [ ]
- 4. Divorced..... [ ]

1.6 Occupation of the household head

- 1. Agriculture..... [ ]
- 2. Employed..... [ ]
- 3. Registered business..... [ ]
- 4. Petty business..... [ ]
- 5. Others (specify).....

- 1.7 Family size .....
1. Number of adults.....Males.....Females.....
  2. Number of children..... Males.....Females.....

## 2.0 Spatial location/ residence

- 2.1 Household location
1. Urban
  2. Peri-urban
- 2.2 Settlement characteristic
1. Surveyed/planned
  2. Not surveyed/unplanned
- 2.3 Settlement structure
1. High density
  2. Medium density
  3. Low density
- 2.4. Settlement topography
1. Valley
  2. Low lying/ plain
  3. Hilly
- 2.5. House ownership
1. Owner
  2. Rented
  3. Other (specify).....
- 2.6 House construction materials
1. Walls: stones  cement bricks  mud   
Wooden poles and mud  others (specify).....
  2. Roof: iron sheets  tiles  concrete   
Thatch grass  others (specify).....
  3. Floors: cement  tiles  mud/earth   
Wooden  others (specify).....
- 2.7 Source of energy for
1. Lighting:
    1. Electricity  2. Kerosene lamp
    3. Hurricane lamp  4. Fire wood
    5. Solar  6. Others, specify.....
  2. Cooking/boiling drinking water
    1. Electricity  2. Kerosene  3. Charcoal
    4. Fire wood  5. Gas  5. Others, specify.....

## 3.0 Water Services

- 3.1 Do you have a piped water connection?
1. Yes  2. No
- 3.2 If the answer in 3.1 is yes, how much (metered/flat rate) do you pay per month for the water bill? .....
- 3.3 If the answer in 3.1 is No, what is the reason for not connecting to piped water system?
1. Can't afford cost of installation
  2. Can't afford monthly fee

3. Have own well
4. Others (specify).....
- 3.4 If the answer in 3.1 is No, where do you obtain water for domestic use?
1. Public water tap/kiosk
2. Neighbour's house water tap
3. Water vendors
4. Others (specify).....
- 3.5 If water is obtained from water vendors, how much do you pay for water obtained from water vendors?
1. Per month .....or
2. Per 20 litre container.....
- 3.6 Can you estimate the distance from your home to your main water source?
1. Public water tap/kiosk  .....metres
2. Shallow well with water pump  ..... metres
3. Shallow well without water pump  ..... metres
3. Lake/pond  .....metres
4. River /stream  ..... metres
5. Other source (specify) .....
- 3.7 Do you pay for water obtained from the above sources of water?
1. Yes  2. No
- 3.8 If the answer in 3.7 is yes, how much do you pay?
1. Per month .....or
2. Per 20 litre container .....
3. Other form of payments (specify).....
- 3.9 Who is responsible for maintaining the water source?
1. Owner
2. Government
3. Community members
4. Others (specify) .....
- 3.10 How is the water source maintained/ managed?
1. Owner's fund
2. Government funding
3. Water users' association fund
4. Community labour and money contribution for repairing
5. NGOs financing
5. Others (specify).....
- 3.11 Who is responsible for routine water collection for the household?
1. Mother (Woman)  2. Father (Man)
3. Both mother (Woman) and father (Man)
4. Girls and boys
5. Mother (Woman), girls and boys
6. Others (specify).....
- 3.12 Can you estimate the average time taken to collect water (to and from journey) from the nearby water source?
1. Less than 10 minutes
2. About 10 minutes
3. More than 10 minutes
4. Do not know
5. Others-specify.....

3.13 Do you have to queue at the water source?

1. Yes  2. No

3.14 If the answer in 3.13 is Yes, can you estimate the average waiting time at the water source?

1. Less than 20 minutes   
 2. About 20 minutes   
 3. More than 20 minutes   
 4. Do not know

3.15 Why do you have to queue at the water source?

1. Too many people collecting water   
 2. Low water volume discharge   
 3. Intermittent water flow   
 4. Water rationing   
 5. Others (specify.....)

3.16 What is the critical time of the day people normally have to queue at the water source?

1. In the morning 7.00 a.m -11.00 a.m   
 2. After noon 1.00 pm – 2.00 pm   
 3. Evening 3.00 pm- 6.00pm   
 4. Throughout the day

3.17 What is the critical season of the year when people normally have to queue at the water source?

1. Dry season   
 2. Rainy season   
 3. Throughout the year

3.18 What are your personal views on water availability in your area?

1. Readily available   
 2. Not easily available   
 3. Not available   
 4. Problematic

3.19 Did you have a water shortage related social conflict(s) with your spouse or other household members?

1. Yes  2. No

3.20 If the answer in 3.19 is Yes, what was the cause?

.....

3.21 What was the solution for the conflicts mentioned in question no 3.19?

.....

#### 4.0 Sanitation Services

4.1 Do you think is it necessary to boil drinking water obtained from the source?

1. Yes  2. No

4.2 If the answer in 4.1 is No, why it is not necessary to boil drinking water? .....

4.3 If the answer in 4.1 is Yes, why .....

4.4 Do you wash your hands with soap after visiting the toilet?

1. Yes  2. No  3. Necessary

- 4.5 Do you wash your clothes and utensils at the water source?  
 1. Yes  2. No
- 4.6 Do you bath at the source?  
 1. Yes  2. No
- 4.7 Are you aware of some health problems that are caused by improper disposal of human excreta?  
 1. Yes   
 2. No
- 4.8 If the answer in 4.4 is Yes, what are those problems? .....
- 4.9 Did you experience any of these problems at your home?  
 1. Yes  2. No
- 4.10 If the answer is yes,  
 What were the problems? .....  
 When did they occur? .....
- 4.11 Did you have a case of gastro-enteritis in under-five children in your home within the past two months?  
 1. Yes  2. No
- 4.12 If the answer in 4.6 is Yes, what do you think was the source of infection?  
 .....
- 4.13 Do you have a toilet facility for your family?  
 1. Yes  2. No
- 4.14 If the answer in 4.13 is No, where do you go for a call of nature?  
 1. There is nearby public toilet facility   
 2. Neighbour household's toilet facility   
 3. Others, (specify).....
- 4.15 If the answer in 4.13 is Yes, what type of toilet facility do you have?  
 1. Pit latrine   
 2. Pour flush toilet   
 3. Flush toilet   
 4 Others (specify).....
- 4.16 If the toilet facility is a flush toilet, do you have a sewer connection?  
 1. Yes  2. No
- 4.17 How do you empty your pit latrine or septic tank when it overflows?  
 1. Hiring emptying facilities from private companies   
 2. Emptying services from City Council by cost sharing or at a cost   
 3. Cesspit connected to main sewerage system   
 4 Other means (specify).....

**THANK YOU FOR YOUR COOPERATION!**

## Appendix 2: Questionnaire for the Ward and Village Executive Officers

**Instructions:** Please provide information on the following questions by putting a  $\checkmark$  mark against a selected answer or fill in your answer in the space provided. Note that the information you provide will be confidential and used only for academic purpose.

Name..... Age.....

Date of interview.....

District.....

Ward..... Village.....

Designation\*: WEO/VEO.....\* delete accordingly

### 1.0 Respondent's background information

#### 1.1 Sex

1. Male

2. Female

#### 1.2 Education level

1. No formal education

2. Primary education

3. Secondary education

4. Post secondary education

5. Others, (specify) .....

### 2. Water services

#### 2.1 What is the total number of households in your Ward/Village?

.....

#### 2.2 What is the major source of drinking water in your Ward/Village?

1. Piped water supply

2. Pumped shallow and deep wells

3. Protected springs

4. Others (specify).....

#### 2.3 What is the total number of public water taps/wells in your area?

.....

#### 2.4 What is the average number of households per public water taps/wells in your area?

.....

#### 2.5 Is there piped water supply shortage problem in your area?

1. Yes

2. No

2.6 If the answer in 2.5 is Yes, what do you think are the causes of piped water shortage?

- 1. Intermittent water flow at the source [ ]
- 2. Low water pressure [ ]
- 3. Water not available at the source [ ]
- 4. Others (specify).....

In your opinion what can be done to rectify the situation?

.....

2.7 Have you ever experienced any water shortage related social conflict(s) within household members or among households brought to your attention for reconciliation?

- 1. Yes [ ] 2. No [ ]

2.8 If the answer is Yes, what was the cause?

- 1. Causes of conflicts within household members  
.....
- 2. Causes of conflicts among households

2.9 Are there streets of sub-villages in your ward/village with persistent water shortages?

.....

2.10 If the answer in 2.9 is yes, what the causes of water shortages? .....

2.11 What are the common water-borne diseases in your ward/ village?

.....

**3.0 Sanitation services**

3.1 What is the number of households with toilet facilities in your area? .....

3.2 Is there sewerage system connection in your area?

- 1. Yes [ ] 2. No [ ]

3.3 If the answer in 3.2 is yes, what is the number and names of streets with sewerage system? .....

3.4 If the answer in 3.2 is yes, what is the number households with toilet facility connected to sewerage system? .....

**THANK YOU FOR YOUR CO-OPERATION!**

### Appendix 3: Checklist for unstructured interview with the MWAUWASA Director

Date of interview .....

#### 1. Water infrastructures

1. Capacity of the water pumping plant (s) per day/month .....
2. The number and capacities of water storage facilities available.....
3. The number of households with metered piped water supply .....
4. The number of public water tap or kiosks .....
5. The number of households with toilet facilities connected to sewerage system.....
6. The average number of households receiving cesspit emptying services per month.... ..

#### 2. What are the major constraints toward achieving the following obligations?

- i. Ensuring that consumers are continuously supplied with adequate, safe drinking water and sanitation services .....
- ii. Ensuring that wastewater is collected, treated and disposed in an environmentally friendly manner through the sewerage system.....
- iii. Setting drinking water and sewerage tariffs that do not marginalize certain residents in Mwanza City .....
- iv. Ensuring improved water and sanitation services in low income and peri-urban areas .....

#### 3. Is there any precondition for provision of house water connections in informal settlements or squatter settlements?

1. Yes [ ] 2. No [ ]

#### 4. If the answer in question 3 is Yes, what are these preconditions?

#### 5. Does the MWAUWASA require households to pay water connection charges?

1. Yes [ ] 2. No [ ]

#### 6. If the answer in question 5 is Yes, what is the cost of connection to piped water supply?

#### 7. Does the MWAUWASA require households to pay sewerage services connection charges?

1. Yes [ ] 2. No [ ]

#### 8. If the answer in question 7 is yes, what is the cost of household sewerage services connection? .....

**THANK YOU FOR YOUR CO-OPERATION!**

**Appendix 4: Checklist for unstructured interview with for the Mwanza City  
Health Officer**

Date of interview .....No. of streets.....  
No of villages.....No. of households .....

**1.0 Sanitation infrastructures**

1. Overall number of households using toilet facilities.....
2. Households owning flush toilet facilities.....
3. Households owning ventilated improved pit latrines/pour flush toilet .....
4. Households owning pit latrines.....
5. Number households with toilet facility connected to sewerage system?  
.....

**2.0 Are there cesspit emptier services offered by City Council?**

1. Yes [ ]      2. No      [ ]

3.0 If the answer in 3.0 is Yes, what is the cost for the services offered? .....

4.0 What is the average number of households receiving cesspit emptying services per annum or per month? .....

5.0 What are the commonest water-borne diseases in Mwanza City?  
.....

6.0 What are Mwanza City Council's strategies to control water-borne diseases?  
.....

7.0 Are there problems in sewerage services provision in Mwanza City?

1. Yes [ ]      2. No      [ ]

8.0 If the answer in 7 is yes, what are the causes

9.0 In your opinion, what can be done to rectify the situation?  
.....

**THANK YOU FOR YOUR CO-OPERATION!**