THE EFFECT OF WATER INTERVENTIONS ON THE URBAN POOR: AN ANALYSIS OF THE WANDIEGE COMMUNITY WATER SUPPLY PROJECT IN KISUMU

BY

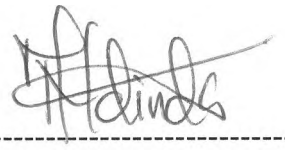
TERRY MUTUNE

A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN ENVIRONMENTAL PLANNING AND MANAGEMENT IN THE DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES, UNIVERSITY OF NAIROBI.

2012

DECLARATION

This research project is my original work and has not been submitted for a degree award in any other University.

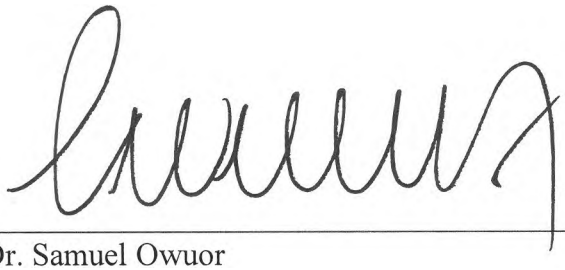


MUTUNE TERRY NDINDA

(C50/71109/07)

Date 9th November 2012

This research project has been submitted for examination with our approval as University supervisors.



Dr. Samuel Owuor

Department of Geography & Environmental Studies

Date 15/9/2012

Dr. Mikalitsa S. Mukhovi

Department of Geography & Environmental Studies

Date 9/11/2012

DEDICATION

To the Supreme Common Good, the common good of the person and of society

ACKNOWLEDGEMENT

I would like to extend my heartfelt gratitude to the staff of the Department of Geography and Environmental Studies. I am especially grateful to my University supervisors, Dr. Samuel O. Owuor and Dr. Mikalitsa S. Mukhovi, for guidance, support and encouragement in carrying out this study. This research formed part of a larger study on *Water Reforms and Interventions in Urban Kenya*: *Impact on the Livelihoods of the Urban Poor.* It involved three bodies: *The University of Nairobi* from which the researcher took part; *Radboud University, Netherlands* from which a masters student - Mr. Howard Ching Chung took part; and *African Studies Center (ASC), Leiden, Netherlands*, which funded the study. The Kisumu study undertaken by the researcher followed from an inventory tour of five towns in Kenya: Nakuru, Eldoret, Kisumu, Homabay and Kisii under the umbrella of the larger study. The inventory was conducted on water and sanitation supply in these towns in October to November 2008 in the context of Kenya's urban water sector reforms and interventions. The choice of study area and the scope of this study were within the larger project's aims and objectives. The study was conducted as joint fieldwork with the masters student from Radboud University. Data collected during this fieldwork served two aims: One, data for academic work of the two masters students and two, it formed part of the larger project's database.

This study would not have been possible without funding from the African Studies Center (ASC), Leiden, the Netherlands. I am profoundly grateful. In a very special way, I would like to thank Dr. Dick Foeken of ASC for all his insights in this study. I also extend my sincere gratitude to Dr. Isaiah Nyandega who was invariably available for consultations at various stages in this research, Dr. Marcel Rutten (ASC) for his input in the 'other Kisumu component of this study', to my colleague Howard Ching Chung (Radboud University, Netherlands) for his dedication in our fieldwork.

Mr. Alfred Adongo, team leader (SANA INTERNATIONAL) gave us assistance and allowed us to use their offices and computers; Mr. Edward Luvalla from the Municipal Council of Kisumu assisted us with maps and Global Positioning Systems (GPSs) ; Kisumu Water and Sanitation

Company (KIWASCO) officials: Mr. Marcellus Okuthe, Frank David Ochieng (Public Relations Manager) and Mr. William Mboya (Commercial Manager) spared time from their busy schedules to have interviews with us; field guides in Nyalenda, Bandani and Manyatta led us throughout our field study; the Wandiege Community Water Supply Project officials offered us unparalled support and gave much information on the project; our research assistants - Jairus Odhiambo, Nicholas Moi, Dickens Ochieng and Peter Otieno – toiled with us in sweat and tears to get our fieldwork done. To all these people I say *Ero Kamano!* Mr. George Anyona of Maseno University was pivotal in the water quality analysis for this study. I cannot thank you enough! I indeed appreciate the assistance accorded us by Mr. George Okungu of Lake Victoria South Water Services Board (LVSWSB) together with the LVSWSB staff who undertook our water quality analysis. I am very thankful for the help of all who took part in this project in one way or another.

Finally, to my very wonderful family…What would I be without you? *Muchas gracias!, Ni asanda mũno!* and *Mon Amie*, for this and all. How poor words can be.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PHOTOS

LIST OF BOXES

LIST OF ACROYNMS

CBO:	Community Based Organization
CDF:	Constituency Development Fund
ELDOWAS:	Eldoret Water and Sanitation Company
KIWASCO:	Kisumu Water and Sanitation Company
LVSWSB:	Lake Victoria South Water Services Board
MDGs:	Millennium Development Goals
NGO:	Non Governmental Organization
NYEWASCO:	Nyeri Water and Sanitation Company
WSPs:	Water Service Providers

DEFINITION OF TERMS AND CONCEPTS

Improved & unimproved drinking water sources

These are water sources likely to be of suitable quality. For example a piped water supply into the indwelling; piped water to a yard/plot; a public tap/stand pipe; a tube well/borehole; a protected dug well; a protected spring; and rain water. Water sources that are unimproved are: an unprotected dug well; an unprotected spring; and surface water.

Piped water into dwelling or individual piped water or a household connection: a water service pipe connected with in- house plumbing to one or more taps.

Piped water to yard/plot, also called a yard connection is defined as piped water connection to a tap placed in the yard or plot outside of the house.

Public tap or public standpipe is a public water point from which people can collect water. a standpipe is also known as a public fountain or a public tap. Public standpipes can have one or more and are typically supported by brickwork, masonry or concrete.

Tube well or borehole is a deep hole that has been driven, bored or drilled, with the purpose of reaching ground water supplies. Tube wells/ boreholes are usually protected by a platform around the well, which leads spilled water away from the borehole and prevents infiltration of runoff water at the well head.

Protected dug well is one that is protected from runoff water by well lining or casing that is raised above the ground level and a platform that drives spilled water away from the well. A protected dug well is also covered, so that bird droppings and animals cannot fall into the well.

Protected spring is typically protected from runoff, bird droppings and animals by a "spring box", which is constructed of brick, masonry, on concrete and is built around the spring so that water flows directly out of the box into a pipe or cistern, without being exposed outside pollution.

Rainwater refers to rain that is collected from surfaces (by roof or ground catchment) and stored in a container or cistern until used.

Unprotected spring. This is a spring that is subject to runoff, bird droppings, or the entry of animals. Unprotected springs usually do not have a "spring box".

Unprotected dug well. This is a dug well which one of the following conditions is true: 1) the well is not protected from runoff water; or 2) the well is not protected from bird droppings and animals. If at least one of these conditions is true, the well is unprotected.

Surface water is water located above the ground and includes rivers, dams, lakes, ponds, streams, canals and irrigation channels

Improved sanitation: A sanitation facility that hygienically separates human waste from human contact. The types of technology that meet this criterion are: flush to pipe sewer systems; flush to septic tank; flush/ pout to pit; compositing toilet; Ventilation Improved Pit latrine (VIP); and a pit latrine with a slab. A pit latrine without a slab/ open pit does not meet this criterion.

A flush toilet uses a cistern or holding tank for flushing water, and a water seal (which is a U-shaped pipe below the seat or squatting pan) that prevents the passage of flies and odours. A modern ablution block may have several flush toilets and bathrooms.

A traditional pit latrine (open pit) is a rudimentary hole on the ground where excreta is collected.

A pit latrine with a slab is a dry pit latrine that uses a hole in the ground to collect excreta and a squatting slab or plat form that is firmly supported on all sides, easy to clean and raised above the surrounding ground level to prevent surface water from entering the pit. The platform has a squatting hole or is fitted with a seat. A sand platform is an example of a pit latrine with a slab.

A VIP latrine is a dry pit latrine ventilated by a pipe that extends above the latrine roof. The open end of the vent is covered with a gauze mesh of fly-proof netting and the inside of the superstructure is kept dark.

A compositing toilet / eco sanitation is a dry toilet in to which carbon rich material (vegetables wastes, straw, grass, saw dust, ash) are added to the excreta and special conditions maintained to produce inoffensive compost.

No sanitation facility includes defecation into the bush or field or ditch; excreta deposited on the ground and covered with a layer of earth (cat method); excreta wrapped and thrown into garbage (flying toilet) and defecation into surface water.

Unaccounted for water (UFW): It is the difference between the quantity of water supplied to a city's network and the metered quantity used by customers. UFW has two components: (a) physical losses due to leakage from pipes and, (b) administrative losses due to illegal connections and under registration of water meters.

Full cycle: Time taken to go to the water source, fetch water and carry it back home in one trip.

Off plot water sources: These are water sources located on a plot other than the one where the household is residing

ABSTRACT

The study sought to establish the households' access to water and sanitation among the urban poor in Kisumu's informal settlements in the context of a water intervention project (The Wandiege Community Water Supply Project in Manyatta B, herein also referred to as The Wandiege Project). The objectives of the research were: to describe Wandiege Community Water Supply Project ; to determine the status of access to water and sanitation among intervention households (Wandiege Connected and Wandiege Unconnected) and non intervention households (Bandani) and finally to determine the effect of the Wandiege Project on the households it served. To guide in achieving these objectives, the study used two null hypotheses: (1) the cost accessing water had no effect on the cost of food and (2) the number of persons sharing one sanitation facility had no effect on the number of water borne diseases that had occurred in the year.

Data was obtained using the questionnaire as the main data collection instrument from which a sample of 123 households was drawn (Wandiege Connected-34 households; Wandiege Unconnected 29- households; Bandani 60 households) using mixed sampling approach. The data was subjected to both exploratory and inferential statistical analyses. The exploratory techniques were used in providing accurate description of the sample data in terms of frequency distribution tables while inferential statistics of Spearman's Rank correlation were used as a measure of association of different parameters. Statistical tests in all cases were at $\alpha = 0.05$ (95%) confidence level.

The results showed that Wandiege Connected and Wandiege Unconnected households had access to potable water unlike their Bandani counterparts. However, all households accessed severely contaminated water as their alternative source during water shortages. Wandiege Connected households were better in terms of access to water and sanitation facilities as compared to Wandiege Unconnected and Bandani households. For example, water collection time was 7 minutes for Wandiege Connected households as compared to 31 minutes for Wandiege Unconnected households and 42 minutes for Bandani households; per capita water consumption was 28.7 liters for Wandiege Connected households as compared to 24.7 liters

among the Wandiege Unconnected households and 20.4 liters among Bandani households. In terms of access to sanitation facilities, there were less people sharing sanitation facilities among the Wandiege Connected households (48%) as compared to Wandiege Unconnected (61%) and Bandani (73%). There were also less incidences of water borne diseases in the year for Wandiege Connected households (13.7%) as compared to Wandiege Unconnected (29.4%) and Bandani households (41.6%).

The study concluded that Wandiege Connected households were better served in terms of access to water and sanitation in many respects as compared to Wandiege Unconnected and Bandani households. As far as access to water is concerned, an intervention that would provide individual piped water connections to households was better than one that availed water through kiosks as it would avail water at a price cheaper than that in areas without water interventions like Bandani. Reduced costs of water would in turn translate into nutritional benefits for the households. The study also concluded that access to more sanitation facilities was important in reducing incidences of water borne disease. Nutritional benefits from a cheaper water supply and health benefits from less incidences of water borne diseases would make a positive contribution toward households' livelihoods.

The study made policy and research recommendations: in terms of policy, the study recommended (1) that policy makers should promote water interventions geared towards increasing individual piped water connections for the urban poor and (2) that policy makers should work towards increasing the number of sanitation facilities for the urban poor. The study made two research recommendations: (1) Further research should be conducted on the role of water for household livelihoods by concretizing the effect of water availability on each of the households' capital assets: Physical, human, financial, social, natural and political assets and (2) Further research should also be conducted on various factors related to access to water and sanitation such as establishing the correlations between: water collection time and per capita water consumption; per capita water consumption and cost of water; willingness to pay for water supply improvements and water collection time; number of water borne diseases and sources of water; number of water borne diseases and per capita water consumption; and number of water borne diseases and rate of sensitization on use of sanitation facilities.

CHAPTER ONE: INTRODUCTION

1.0 Introduction

This introductory chapter gives the background of the study problem as well as a description of the study area.

1.1 Background to the Study Problem

The importance of water for socio economic development cannot be overemphasized. It is a vital part of social infrastructure with key roles in health and human welfare. Access to water and sanitation can make or break human development. They are fundamental human rights and intrinsically important indicators of human progress. They give substance to other rights and are a condition for attaining wider development goals (UNDP 2006). Access to water has been recognized as a human right in numerous international treaties and declarations, as well as by the UN Committee on Economic Social and Cultural Rights. Furthermore, international development commitments such as sustainable development and poverty eradication are largely dependent on access to water (Nyangena 2008).

Access to safe water has been one of the top priorities in developing countries over the past three or four decades and billions of dollars have been invested in the pursuit of this goal. World leaders have been committed to expanding access to water services as exemplified by Millennium Development Goals for 2015 which include a goal to halve the proportion of people without access to safe drinking water (UNDP 2006). In sub- Saharan Africa, various strategies have been adopted to increase water supply and sanitation coverage. These are either under the public sector e.g. Burkina Faso, Namibia and Botswana (Bayliss 2003) or the private sector e.g. Guinea, Senegal and Ivory Coast (Bayliss 2001).

1.2 Statement of the Research Problem

Much has been written about the appropriateness of the public sector and the private sector in the supply of water and sanitation services e.g. Davis (2005); Prasad (2006).These studies focus on the relative strengths or weaknesses of either mode of service provision such as enterprise

performance, regulation of the utility, the role of politics in service provision, extent of risk transfer (Bayliss 2003).

It has been observed that dwelling on the public-private dichotomy diverts attention from the important roles played by Civil Society Organizations (CSOs) in water and sanitation services (Budds & McGranahan 2003).

Literature on private sector participation in water and sanitation provides very little information or analysis regarding small towns or rural communities that have involved the private sector in water and sanitation delivery services and particularly at household level (Davis 2005). At the household level, access to water and sanitation services provide a host of benefits for the person in as far as access to water can and does influence livelihoods and livelihood circumstances. Few studies show the outcomes of private sector participation at household level, especially the role of access to water in the improvement of livelihoods among the poor households e.g. Gulyani, Talukdar & Mukami (2005); Nicol (2000); Crow & Odaba (2010); Were, Swallow & Roy (2006).

1.3 Research Objectives

The broad objective of the study was to assess the effect of water interventions on the urban poor. The study addressed the following specific objectives:

1. To describe the Wandiege Community Water Supply Project in Manyatta B
2. To analyze the current status of access to water and sanitation among intervention (Wandiege Connected and Wandiege Unconnected households) and non intervention households (Bandani).
3. To assess the effect of the Wandiege Project on the households it served.

1.4 Research Questions

In order to achieve the stated objectives, the study set out to answer the following research questions

1) What is the structure, management and operation of the Wandiege Community Water Supply Project?

2) How is the access to water and sanitation situation among intervention (Wandiege Connected and Wandiege Unconnected households) and non intervention households (Bandani)

3) What is the effect of the Wandiege Project on the households it served?

1.5 Research Hypotheses

1) Cost of water has no effect on the cost of food
2) Number of persons sharing one sanitation facility has no effect on the number of water borne diseases in the year

1.6 Justification of the Study

In many countries, it is considered the role of the state to ensure that citizens have access to water and sanitation services. Some arguments have been put forward to support the state as the most appropriate provider of these services. First, water and sanitation services are considered public goods. It has been argued that it is better to leave the provision of water and sanitation services to the public sector in order to ensure public interest (Budds & McGranahan 2003). However, according to K'Akumu (2006), the concept of public good is no longer tenable on account of three factors: one, water is no longer abundant in urban areas; two, environmental degradation has compromised water quality such that consumers end up making choices of the water to consume depending on its quality; three, consumption of one group exempts the other. If water were to be provided by the private sector, it would not necessarily rule out public interest.

Secondly, according to Marvin and Laurie (1999); Budds & McGranahan (2003); Bakker (2003), the water enterprise approximates a natural monopoly. A natural monopoly is one in which total costs are lower when a single enterprise produces the entire output for a given market than when any two or more enterprises divide production costs among them. However, a natural monopoly must not only be a public one; and public operation and ownership are not the only response to the problem of natural monopolies. It has been observed that there are innovative ways in which competition can be introduced in a natural monopoly (K'Akumu 2006).

Thirdly, access to water is a human right endorsed by international conventions. According to Prasad (2006), the government has the obligation to provide water to every citizen. However, the state does not have to engage itself in water and sanitation supply in order to ensure that human rights are not violated. The state can establish a system of justice and equity to ensure human rights.

Private sector participation in water and sanitation supply had been vouched for on the basis of two arguments. One, that water is an economic good that can be exchanged in the market for a price. As water is a finite resource, it ought to be used in a sustainable and economic manner. Two, advocates of private sector participation have implicated the state for inefficiency, corruption, inability to rehabilitate and maintain water supply and sanitation infrastructure and failure to supply adequate water and sanitation especially among the urban poor (Prasad 2006).

A few studies examine the performance of the water supply enterprise at household level. At household level, an understanding of the role of water for livelihoods and especially the livelihoods of the urban poor is required. This knowledge is necessary so as to design water interventions that support and enhance livelihoods of the poor.

1.7 Scope and Limitations of the Study

The study has limited itself to studying a Community Based Organization (CBO) serving as a water service provider. Thus, the aim of this study was to analyze the Wandiege Community Water Supply Project and its effect on the households it served. To assess the effect of water interventions, the study compared 3 settings: one in which the water intervention provided individual piped water connections to households (Wandiege Connected), another in which the water intervention availed water mainly through water kiosks (Wandiege Unconnected) and another (Bandani) which had no water supply interventions at all.

The study experienced a few limitations. These were:

- Poor Documentation

At the time of this study in November 2009, the project had no official documentation on its history, operations and managerial aspects. The study therefore had to rely on focus group discussion as its main source of information.

- Access to limited Data from Health Centers.

As far documentation of water and sanitation related diseases is concerned, the researchers could only access limited data in the health centers. The study therefore had to rely on households to understand which diseases were prevalent in the area. The study also interviewed public health officials on the diseases prevalent in the study area to augment the data from one health center and from the households.

1.8 An Overview of the Study Area (Kisumu)

This section describes the study area in terms of its geographical characteristics, settlement and its supply of water and sanitation.

1.8.1 Kisumu

Kisumu is one of Kenya's most important urban centers. It is located on the eastern shores of Lake Victoria at Winam Gulf between latitude 34° 55′ to 35′ 55′N and longitude 0°00′ to 01° 12′E. Kisumu covers an area of 417 Km^2 including 120Km^2 under water (GoK 2008). Kisumu got its name from a Luo word "Kisuma" which means a place where the hungry get sustenance. In pre-colonial times, it was an important market for barter trade. In 1898, Kisumu served as an important railway terminus, and thus it got its origin as a town. Over the years, the town experienced rapid growth on account of its significance as a transport, communication and railway center (UN HABITAT 2005).

In terms of topography, Kisumu lies at a height of 800 to 1900 meters above sea level (GoK 2008). The North of Kisumu is hilly while the south is a plain. Winam Gulf is at the tip of the hill which rolls gently covering central parts of the town including slum areas of Manyatta B and Nyalenda. Most of this land is liable to flooding (UN HABITAT 2005). Kisumu is drained on the eastern side by rivers Kibos, Nyamasaria, Luando and Lielango while the western side is drained by rivers Nyangori, Muguruk, Kisian and Awach (KCC 2005).

As far as settlement is concerned, Kisumu exhibits a settlement pattern that is partly planned and partly unplanned. For example, the central part of Kisumu (such as Milimani estate and the Central Business District) is well planned and is home to high and middle income residents. Surrounding the central part is a slum belt that is unplanned and is home to low income residents. There are 7 slums in number namely: Kogony (Bandani), Kanyakwar (Obunga), Manyatta (A&B), Nyamasaria, Nyalenda (A&B), Kaloleni and Manyatta Arab.

1.8.2 Water and Sanitation

Kisumu is located on the shores of the second largest fresh water lake in the world. Nevertheless, it experiences chronic water shortages. It is apparent that supply of water and sanitation has not been keeping abreast with its rapid population growth (Maoulidi 2010). Moreover, the pattern of water distribution leaves a lot to be desired (UN HABITAT 2005). For instance, the central and well-planned area is well served by the main water supply utility - Kisumu Water and Sewerage Company (KIWASCO). Conversely, in the unplanned settlements and peri urban areas, there is lack of access to clean water and proper sanitation facilities. Households experience unreliable water supply, pay high prices for water and utilize water of poor quality (Maoulidi 2010).

All water and sewerage facilities in Kisumu are owned by the Municipal Council of Kisumu (MCK). The MCK in line with the requirements of the Water Act 2002 has undertaken steps to privatize its water supply and sewerage facilities; thus KIWASCO came into being (Maoulidi 2010). KIWASCO has the mandate to effectively and efficiently provide adequate water to customers. Yet, only 32-35% of the total population is served by the water network (Owuor & Foeken 2009). KIWASCO is the largest provider of piped water. KIWASCO gets its water mainly from Lake Victoria. A small percentage of KIWASCO's water is abstracted from River Kibos. KIWASCO has two water supply systems: an electrical pump system at Lake Victoria and a gravity system at Kibos River. Water from Lake Victoria is treated at KIWASCO's Dunga treatment plant, 0.6KM from the intake point and is then pumped to a storage tank in Kibuye, ready for distribution. KIWASCO has to contend with challenges such as receding lake levels as

the lake has been receding with the passage of years, and high costs of treating water as the lake is polluted by hyacinth weeds (Owuor & Foeken 2009).

KIWASCO produces 18000m³ of water per day against a projected demand of 45,000m³ per day (LVSWSB 2008). In a day, this amount of water produced leaves the city with a deficit of 27,000m³ (Ong'or & Long-Cang (2007); Owuor & Foeken (2009); Maoulidi (2010). The shortfall in water production and consequently in water available for distribution is further aggravated by the high levels (62%) of unaccounted for water within KIWASCO's water supply infrastructure (Owuor & Foeken 2009).

Kisumu residents rely on various water sources ranging from individual pipe water connections, yard water tap connections, public water taps, boreholes, springs, the lake, water vendors and water kiosks. As of September 2008, KIWASCO had 7,704 domestic water connections. In informal settlements, although some residents have access to piped water, most residents rely on water kiosks, hand cart vendors and shallow wells for their water supply. The reliance on water from shallow wells in these settlements is problematic because water from these sources is poor in quality. Besides, in the rainy season, pit latrines are a nuisance as they overflow and contaminate water in shallow wells. Dependency on such water sources contributes to dangerous outbreaks of water borne such as cholera, dysentery and typhoid (Maoulidi 2010).

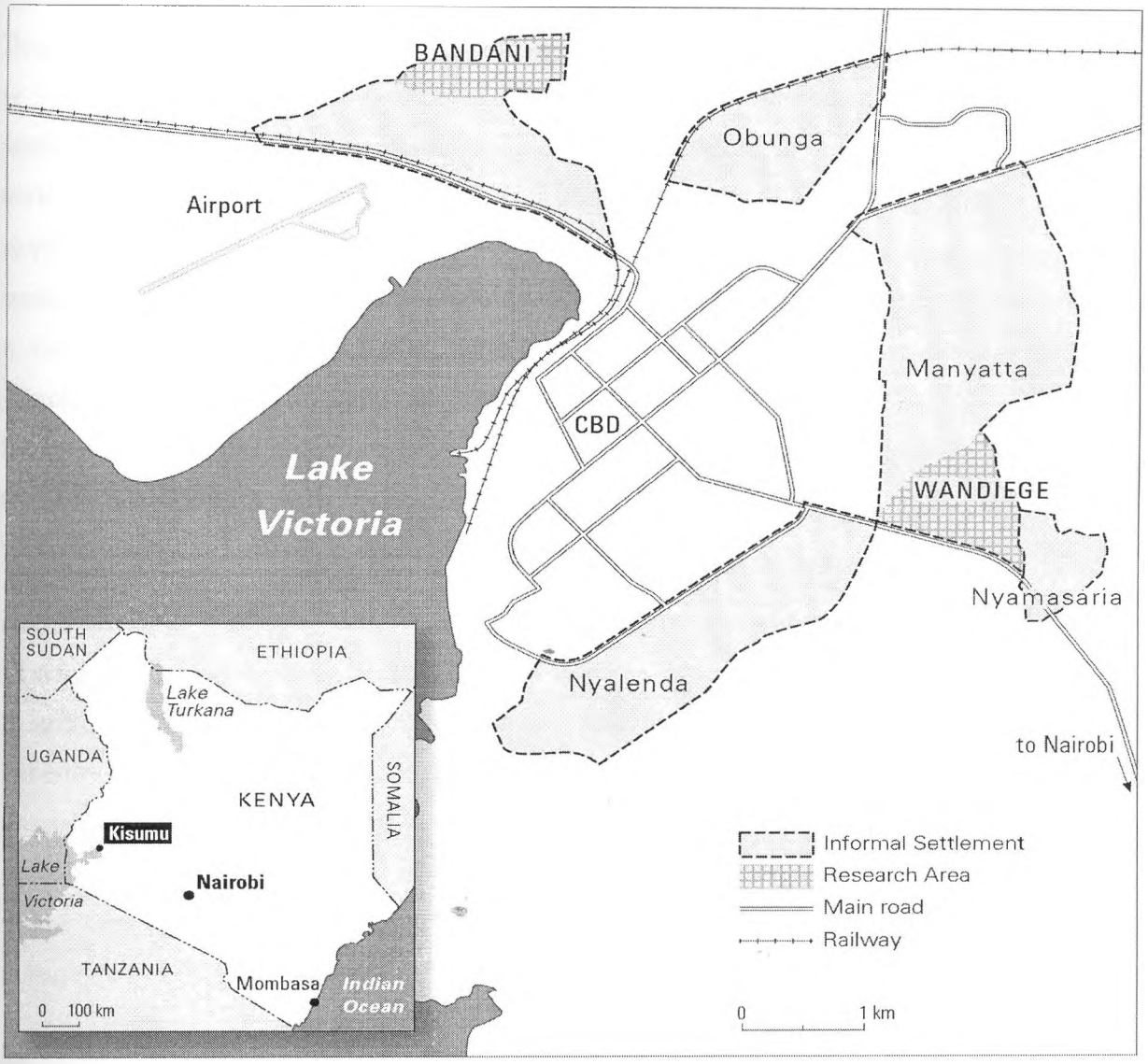
Apart from KIWASCO, there are other water service providers such as the Gulf Water Company serving peri urban and rural parts of Kisumu and also small scale community water service providers such as the Wandiege Community Water Supply Project in Manyatta B. Like KIWASCO, these other water service providers came into being with the inception of the Water Act 2002.

1.8.3 Manyatta and Bandani

Manyatta B and Bandani grapple with problems of access to water and sanitation. Most water sources in these two areas are unimproved. Sanitation facilities are predominantly pit latrines (the traditional type). These traditional pit latrines are usually shallow (less than 4 feet deep) and

therefore fill up quickly. In addition, they are prone to collapsing on account poor soil structures in Kisumu (UN HABITAT 2005). Manyatta B has a water intervention project (the Wandiege Project) at Wandiege primary school. This water intervention serves about 10,000 people with potable water. Bandani is not served by KIWASCO and has no water interventions at all.

Figure 1.1: Location of Kisumu in Kenya and sampled households in the study area.



Source: Dick Foeken 2012

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

This chapter entails a review of literature on urban water and sanitation and the livelihoods of the urban poor. It also gives the conceptual framework of the study.

2.1 Water and Socio Economic Development.

Clean water and sanitation are among the most powerful drivers of human development. This is by virtue of the fact that they extend opportunity; enhance the person's dignity as well as creating a cycle of improving health and raising wealth. However, in our increasingly prosperous world, 1.1 billion people in the developing countries lack access to water and another 2.6 billion people lack access to basic sanitation services (UNDP 2006). As such the crisis of water and sanitation is a challenge that remains daunting in the early 21st century. When people lack access to water and sanitation, they suffer deprivation, their livelihoods and liberties are curtailed (Akech 2009). The cycle of deprivation emanating from deficiencies in water and sanitation is the thrust of the MDG goal 7 target 10: to halve the proportion of people without sustainable access to safe drinking water. Access to water is so crucial that the attainment of all the other MDGs is directly or indirectly linked to access to water.

Essentially, water is a basic need, without a direct substitute and at the same time, it is necessary for safeguarding public health. Access to water is also a basic human right that entitles everyone to sufficient, affordable, physically accessible, safe and acceptable water for personal and domestic uses (UN ECOSOC 2002). "When an individual does not have access to safe, affordable water to satisfy his/her drinking, hygiene or livelihood needs, that person is water insecure, but when a large number of people in an area are water insecure for a significant period of time, then that area is water scarce" (Ong'or & Long- Cang 2007: 486). For a large section of humanity, this human right to water is widely violated due to water scarcity.

2.2 Public and Private Sector Participation Water and Sanitation Supply

In many countries, water and sanitation services have traditionally been provided by the state. Several studies have given insights into the performance of public water supply utilities in the developing world. In the case of sub-Saharan Africa, it was observed that the role of the state and its eligibility in water supply was increasingly come into question. For example, (Budds & McGranahan 2003) remarked that public water supply utilities were too slow in extending water and sanitation services and that they were also inefficient and corrupt. Policy makers were advocating for abdication of the state in favour of private sector participation K'Akumu (2006); UNECA (2005). In many cases, water leakage levels had been high due to ageing infrastructure and illegal water connections. Furthermore, public water sectors had weak billing and revenue collection mechanisms and tariff structures that failed to recoup costs. In addition, public sector organizations were noted to be notorious for not paying their water bills thus contributing to unsustainability of water sectors of their respective countries. However, that experience was not universal. For instance, in some parts of sub-Saharan Africa, the public sector was effective in water supply as in the case of Burkina Faso, Namibia and Botswana (Bayliss 2003).

It was pointed out that throughout the 20th century, one was hard pressed to find water and sanitation agencies that had no private sector involvement in their operations at all (Davis 2005). In some of these countries, privatization of water supply services was done with the objective of improving transparency, accountability and service delivery. In the water sector, ownership of capital assets such as piping infrastructure was retained by the state whereas the private water supply enterprise took on the challenge of operation of the water supply network. Other aspects of water sector reforms included tariff adjustments, ring fencing of finances and introduction of contracts where the private water enterprise was required to meet specific objectives, such as for instance wider coverage of water supply networks (GTZ 2008).

Although privatization of public infrastructure has been the mantra of many development agencies since the 1980s, private sector participation in water service delivery has had mixed results in several important respects. For example, Prasad (2006; 669) asserted that "the private

sector seems to be no more efficient than the public sector". In the case of sub- Saharan Africa, (Prasad 2006) like (Bayliss 2003:.507) took note "that the performance of the privatized utilities does not change dramatically: the enterprise continues to perform well, or not so well, depending on their state when they were privatized and on the state of the wider economy".

It was argued that the debate on the more superior mode of water and sanitation supply, either by the public or private sector, obscured the roles of various actors in water and sanitation supply such as CBOs (Budds & McGranahan (2003). In this respect, (Davis 2005) made two observations: one, that literature on private sector participation in the water sector provided very little information or analysis regarding the experience of small towns and rural communities that had engaged the private sector in water and sanitation delivery, and two, that literature on privatization of water and sanitation delivery systems was replete with "advocacy research" and was somewhat thinner with respect to theoretical and empirical examinations.

For instance, studies undertaken revealed that empirical evidence was scant on the situation of poor households with regard to access to water and sanitation in the context of privatization Nilsson &Nyanchaga (2008); Maoulidi (2010). Thus accessibility and affordability of water by low- income households had remained a persistent challenge. A study by (Budds & McGranahan 2003) also alluded to this claim when it indicated that low - income settlements did not represent an attractive market (for the water supply utility operator) because they were too poor to be profitable and that they represented too great a financial risk. Therefore, there was need for research particularly into the impacts generated when low - income households were excluded from privatized water supply (PSIRU 2001).

2.3 Water and Sanitation Provision in sub-Saharan Africa

It has been noted that in low and middle income countries, public water supply and sanitation systems typically leave a lot to be desired (Kjellen & McGranahan 2006). For example, water supply systems function poorly and coverage levels are deplorably low, such that they allow spread of infectious diseases. Furthermore, urban poverty is on the rise in sub- Saharan Africa with more poor people moving from rural to urban areas (Owuor & Foeken 2009). It was also noted that with increased rural to urban migration and growth of informal settlements, population

and poverty, African governments needed to be able to provide access to safe water for 210 million additional urban residents over the next 15 years (UNECA 2005). It was also estimated that almost 300 million Africans would be living in informal settlements by the year 2020 and that 20-50% of the urban population will not have reliable access to water and sanitation services (RTI 2001).

Increasing urbanization and rise in poverty imply that the urban poor have to resort to cheap housing alternatives usually found in the unplanned settlements, commonly deficient in amenities. In the case of water and sanitation supply, it was observed that poor urban dwellers tended to live in smaller, low- income neighbourhoods within larger cities which large water companies showed little interest in serving. The resultant effect has been that the urban poor in the region have continued to experience neglect in provision of adequate water and sanitation services (Budds & McGranahan 2003).

Sub-Saharan Africa has over the last two decades witnessed concerted efforts to remedy its lethargic public water and sanitation sectors. The search for alternatives to revive these sectors have almost invariably converged on private sector participation. For instance, (Bayliss 2003) reported privatization of water supply sectors in fourteen countries in the region. Documenting private sector participation in the region, several authors Budds & McGranahan (2003); Bayliss, (2003); Davis (2005); RTI (2005) and Prasad (2006) pointed at deficient provision of water and sanitation services for the urban poor within reformed or private water supply entities.

Kenya, like some countries in sub- Saharan Africa, also opted to reform its water sector. The reforms were initiated in the early 1990s and culminated in the enactment of the new Water Act 2002 (Akech 2009). Kenya opted to commercialize its water sector. The move was aimed at injecting a culture of discipline in which private players transact business for overall national benefit (K'Akumu 2006). The performance of the sector so far has been documented by a number of authors, for example: Wambua (2004); K'Akumu (2006); RTI (2005). These studies are invaluable for understanding private sector participation in the water sector, albeit at sectoral and policy level. There is much to be done to show how households have fared with regard to access to water and sanitation, especially in the case of poor households in the informal

settlements. Community water interventions play a critical role in ensuring access to water (and sanitation) for the urban poor and deserve particular attention. One of these is the Wandiege Community Water Supply Project in Manyatta B, the focus of this study.

2.4 Water Supply in Kenya

One of the impetus for the development of water supply in Kenya was the Kenya - Uganda railway. When the railway reached Lake Victoria in 1901, there was need to supply the station with piped water. Thus for the first two decades of the 1900, the railway was the main water provider for inland towns in Kenya (Nilsson & Nyanchaga 2008).

According to (IEA 2007), the first water Act in Kenya was the Water Ordinance, 1929. Under this act, several government organs acted as policy formulators, regulators and service providers. These were Ministry of Water Resources, Management and Development (MWRMD), National Water Pipeline Conservation, Ministry of Agriculture (MoA), Ministry of Local Governement (MoLG) and Ministry of Livestock and Fisheries (MoLF). There was lack of coordination in these bodies as a result of confusion and overlapping of roles. The Water Ordinance was revised in 1972 when it was renamed Cap 372 of Laws of Kenya.

Kenyas' first attempts to reform its water sector came as early as 1974. Subsequent efforts were witnessed with the Sessional Paper No. 1 of 1999 on National Policy on Water Resource Management and Development. The paper analyzed pitfalls in water resource management, water and sewerage development, institutional frameworks and financing of the sector (GoK 1999). According to GoK (2006), weaknesses in policy, regulation and service provision in the previous set up were the main drivers towards water sector reforms. One of the outcomes of the water sector reform process was that the Water Act 2002 which came into effect in 2003. It repealed the Water Act cap 372.

The Water Act 2002 required that all Kenyan municipalities reform their water services along commercial principles. Among specific objectives of the Water Act 2002, equal access to water for all Kenyan was one of the most immediate issues to be addressed. There was need for private sector financing which opened the way to participation of the private sector, civil society organizations and communities in the management and development of water resources.

Kenya water sector reform efforts have continued to gain momentum over the years. The National Water Policy 2012 (NWP 2012) is a reflection of these efforts. The NWP 2012 is informed by the gains made during the past decade of implementation of reforms in the water sector. It takes into account the requirements of the constitution of Kenya 2010 with respect to right to water for all, the Kenya Vision 2030, the MDGs and other national policies and strategies.

2.5 Empirical Studies on Urban Water Supply

Ahiblame, Engel & Venort (2012) studied water supply systems for domestic uses in urban Togo. More than 50% of the urban population or 25% of the entire population in Togo is concentrated in Lome'. More than 60% of the urban population in Togo do not have access to clean drinking water. Existing water supplies in Togo include bucket drawn wells, mini water towers, rain water harvesting and public piped water. The study employed survey method to identify a household water supply model for households in a residential neighbourhood in Lome'. The study results showed that participants thought highly of a large scale community water tower and expressed interest in maintaining it. The study also argued that time and energy involved in fetching water for daily household uses could be reduced and thus employed in other activities. It was also argued that benefits of water availability combined with reduction of diseases burdens would improve health, productivity, quality of life and many other areas leading to a positive impact on personal and economic growth.

A study conducted by Hardoy & Schusterman (2008) showed how privatized provision of water and sanitation could meet the needs of low income groups, especially those living in informal settlements in Buenos Aires, Argentina. It was noted that private water supply and sanitation providers regarded low income groups as market segment that represented unacceptably high risks as far as their profits were concerned. It was observed that Low- income residents were actively involved in formulation of proposals and participating in solutions to their water supply problems and that they bore a proportion of the cost of improving and maintaining their neighborhoods. In all low- income communities, there were a variety of institutions that could be

involved in participatory activities, including water service provision. Participatory approaches to water supply were proposed as viable in low- income settlements.

A study on the role of small scale service providers in water and electricity supply summarized key findings based on a study 49 countries which had the input of small scale providers of water and electricity supply (Kariuki & Schwartz 2007). There were 10,000 small scale water supply providers and 700 small scale electricity providers in the 49 countries. It was noted that many governments and donors considered CBOs a more appropriate match in service delivery where natural monopoly utilities such as water supply were concerned. It was also observed that small scale utility providers were prevalent in settings in which there were either low coverage levels, where public utilities were inefficient or in regions difficult to access through conventional means.

Water supply, sanitation and associated health impacts in urban poor communities were documented by Karn & Harada (2000). Four informal settlements in Mumbai India were studied by survey method. High incidences of water borne diseases were reported in the slums. Water quality was also poor and sanitation facilities were shared by more than a hundred persons per sanitation facility. Water borne diseases reported in the study were not clinically proven but as reported by respondents. The study recommended safe and adequate water supply for the slum dwellers.

The viability of community based tubewell programmes was studied in rural Nepal (Gao 2002). People used traditional water sources such as surface water bodies and wells due to lack of piped supplies. Coupled with lack of sanitation facilities, there were many incidences of water borne epidemics in which many people became sick or died, particularly in the Monsoon season. In hospitals, more than 50% of the patients suffered from gastrointestinal disorders caused by water borne pathogens. It was noted that the long term solution to the public health problems was to supply piped water as well as disinfecting the water and sewerage treatment facilities. The feasible solution to water supply problems was identified as community based tube well programs.

Ishaku et al. (2010) studied water vending systems in three informal settlements of Yola North in Adamawa State of Nigeria. The methodology consisted of field surveys in which 100 households were observed in each of the three settlements. Responses were solicited concerning households' water sources, per capita water consumption, household size and water demand. More than 60% of households depended on water vended from boreholes, hand dug wells, as well as surface water sources which were delivered by pushed tankers. There was a notable absence of piped water supplies in the study.

Thompson et al. (2001) studied changes in urban water use in East Africa over a thirty year period. The study entailed two facets of empirical examination: first, the impacts of water use and water quality on health and hygiene, and second, an assessment of the range of available water sources, perceptions of water quality and the need for improved water sources. The study posited that relatively little was known about a number of key aspects of domestic water use. As such, factors that influenced domestic water use remained only partly understood. The study argued that the most important factor that affected urban water use in East Africa was whether a household had access to a functioning pipe system. It was also noted that community management of water supply and sanitation systems had gained recognition as critical but a frequently neglected aspect of water development. The study pointed out that the size, number and influence of CBOs and NGOs in the water and health sector in the past two decades warranted special consideration, especially with regard to their roles in the development and implementation of more participatory approaches to water and sanitation provision. The study also observed that per capita water consumption in East Africa had declined considerably over the last 30 years due to low levels of water service coverage.

A study of KIWASCO sought to identify the challenges facing water supply systems in Manyatta (Otiego 2006). The study had, among other objectives, to establish the best approaches in improving water delivery and enhancing effectiveness of community driven initiatives. It was noted that three quarters of community members in Manyatta identified their own representation by CBOs, NGOs and self help groups as their proposed actor for improved water supply. The

study noted the absence of piped water supplies in Manyatta and that water sources were unimproved.

Another study of KIWASCO was carried out by Ong'or & Long-Cang (2007). The study entailed an evaluation of water supply and sanitation coverage and planning in Kisumu for the period up to 2020. Survey and rapid assessment methods were employed in which 329 questionnaires were filled out. The results of this study pointed out the need for local approaches that took into account the uniqueness of the problems of the target areas in solving water and sanitation supply problems. In its recommendation, the study indicated that if adopted, community participation provided the best way forward in management and maintenance of local water and sanitation services. Also recommended was involvement of community members in all stages of water and sanitation programmes as documented in the Water Act 2002.

RTI (2005) studied urban water supply in two towns in Kenya (Nyeri and Eldoret). The study indicated that in addition to formal sector provision of water through public or private sector, there were extensions of sub- contracts signed with community organizations and NGOs. The study argued that water service provision undertaken by community organizations and NGOs was an innovation that deserved additional research as it indicated new forms of mobilizing resources from households and communities.

Gulyani, Talukdar & Mukami (2005) set out to establish how inadequately the urban poor were served by public utilities and small scale water providers. The study provided useful insights on household water supply in three urban centers (Nairobi, Mombasa and Kakamega). Based on a survey of 674 households, the paper examined water use, unit cost and willingness to pay for piped water or yard connections. The study affirmed that access to adequate water was a top priority for both rich and poor households in the three urban centers. The study found that poor households were not likely to have a piped water connection and that they were overwhelmingly dependent on alternative sources. Piped households had higher per capita water consumption (44 per liters per capita) as compared to un-piped households (35 liters per capita). Water collection time was found to vary significantly depending on the primary water source. The poor also spent more time in water collection. For example, non- poor households spent 5 minutes in water

collection daily as compared to poor households who spent 42 minutes daily on the same task. The study also found that households were willing to pay for water supply improvements (76%) rather than maintain the status quo.

Other studies have been undertaken that provide an explanation on access to water and sanitation situation in Kenya's urban centers and more so in Kisumu. For example, UN HABITAT (2005) carried out a situational analysis of Kisumu's informal settlements and provided an overview of accessibility of water and sanitation for the seven informal settlements. The study was part of stock taking for a UN HABITAT slum upgrading programme. The study found that water sources were unimproved and that there was a lack of adequate sanitation facilities in the informal settlements. The study also observed a high prevalence of water borne diseases in the settlements.

CRS (2007) sought to investigate the differences in access and satisfaction from services by the poor and non poor households in Kenya. This study dealt with urban water supply, sanitation and solid waste management in Nairobi, Kisumu and Mombasa. In Kisumu, the study evaluated customer satisfaction for households served by KIWASCO. The study found that only 7% of poor households were connected to KIWASCO's water supply network. Households in Kisumu were found more likely to experience water shortage than those of the other two towns. More than 40% of households in Kisumu experienced water shortage. During water shortage spells, households tended to rely on unimproved sources. The primary water collector was an adult woman (70%). Kisumu households spent the longest time in water collection tasks in normal times (28 minutes in a full cycle) as compared to those of Nairobi (18 minutes) and Mombasa (20 minutes). The time spent on the same task was much longer during water scarcity periods in Kisumu (200 minutes). The study posited that the long time spent on water collection impacted negatively on the wage earning potential of the women, reduced their time to take part in community activities and also that the women suffered from exhaustion. Poor households in Kisumu also spent a higher proportion of their income on water as compared to the other two towns. In terms of sanitation, the study found that households relied mainly on pit latrines, but the study also documented the problem of flying toilets specifically in Manyatta.

Owuor & Foeken (2009) carried out an inventory tour of five towns in Kenya: Kisumu, Eldoret, Kisii, Homabay and Nakuru. The inventory was aimed at providing an understanding of the institutional set up, emerging impacts and challenges in Kenya's water sector reforms and interventions. A survey of the water and supply situation was undertaken in these towns. In Kisumu, the inventory focused on water and sanitation supply as undertaken by KIWASCO, and also gave an overview of the Wandiege Community Water Supply Project in Manyatta B.

Wagah, Onyango & Kibwage (2010) carried out a study aimed at measuring accessibility of water services in Kisumu. The methodology consisted of a cross sectional survey in which 367 households were purposively sampled. The study used Pearson correlation analysis and found a strong positive correlation between household income and daily per capita water use. The study found mean per capita water consumption to be 32.92 liters per day. Higher income neighbourhoods (such as Milimani) were found to have higher per capita water consumption (56.32 liters) as compared to their counterparts in the unplanned settlements (per capita water consumption in Nyalenda was 22.45 liters). The study posited that the distance from the primary water source affected per capita consumption as well as the socio economic status of the households. The study acknowledged the need for upfront investment, rehabilitation and extension of the existing water supply network and upgrading of KIWASCO's water treatment plant.

Maoulidi (2010) carried out field research and presented findings on Kisumu's water supply and sanitation services. The methodology consisted of field research, analysis of data and documents collected from municipal offices as well as a review of literature. The study noted that owing to high water tables in Kisumu, pit latrines overflowed and contaminated water in shallow wells. The study also noted that black cotton soils were not suitable for construction of pit latrines as they were prone to collapsing in the rainy season (March- June). The pit latrines were also found to be less than 6 meters deep and therefore tended to fill up quickly and or overflowed.

Murage & Ngindu (2007) sought to assess sanitary practices of residents of a Kenyan urban slum and fecal contamination of their domestic water sources. The methodology involved a cross-sectional study of 192 respondents from Langas slum in Eldoret, Kenya. The study drew 40

water samples from the water sources used by the respondents for laboratory analysis of coliforms. Main domestic water sources were found to be contaminated by faecal matter owing to close proximity of pit latrines to shallow wells (less than 15 meters) and indiscriminate disposal of excreta by children. The study observed that the ideal intervention for safeguarding water quality was the provision of adequate piped water to all slum dwellers. The study also noted that undertaking basic sanitary improvements was a worthwhile effort. The study recommended more sampling of different water sources.

2.6 Livelihoods of the Urban Poor

According to NZAID (2006), the livelihood of an individual or a household are their means of living. The means on living are based on their capabilities and assets (financial, physical, human, natural, social or political). In the context of household water supply, the capital assets can be explained as follows: Labour power, which may be human or animal draws on physical capital to collect water; buying water requires mobilization of financial capital; natural capital determines availability of water; social capital creates opportunities to raise other forms of capital through the community and may be used to solve common problems; human capital could apply as health of individuals and political capital. Political capital goes beyond social capital by providing exerting influence of policy and government process (Nicol 2000).

Were, Swallows & Roy (2006) studied local organizations of water supply in Western Kenya highlands. Case studies illustrated how rural communities successfully mobilized local investments in water supply in an environment where most groups had failed to do so. The results of the study indicated that safe and easily accessible water had brought a range of benefits to households, especially through activities where women had special responsibilities. For instance, households that had improved access to water reported time savings, improved health, cleaner clothes, increased production of tea seedlings, milk and vegetables. The study observed that one option for expanding coverage of safe productive water supply was to empower individuals and community groups to undertake and operate appropriate water supply infrastructure.

Crow & Odaba (2010) showed that access to water was very crucial for household livelihoods and poverty reduction. It was observed for example that when water collection time took many hours (five or more) in a day, the income generating activities of women in Kibera (an informal settlement in Nairobi) were negatively affected. Some activities also had to be curtailed when water was scarce or unaffordable. For instance, the women reported to have foregone showers and sometimes cooking was reduced to one meal, water was used just for drinking. Per capita water consumption was below the basic water requirement (bwr).

Kimani, Zulu & Undie (2007) studied the health and livelihood implications in the marginalization of slum dwellers in provision of water and sanitation services. The study found that the most immediate concern for slum dwellers in Nairobi was the provision of adequate water and sanitation, and a high prevalence of water borne diseases. The study found that water was provided mainly by vendors and that hygiene was compromised during water shortage periods. Slum dwellers in Nairobi were found to be more vulnerable to morbidities and mortalities as a consequence of poor access to water and sanitation services, coupled with poor environmental conditions. The study pointed out the need for further research aimed at determining the best practices in improving amenities in informal settlements.

The literature reviewed shows that the importance of access to water in as far as it influences households' livelihoods has not been studied much. Therefore there is a need to understand water as an asset and an input for household' livelihoods and especially for the urban poor. Few studies have showed the connection between access to water and household livelihoods such as Nicol (2000); Crow & Odaba (2010); Kimani, Zulu & Undie (2007); Were, Swallow & Roy (2006).

2. 7 Theoretical and Conceptual Framework

The main drivers toward water sector reforms were weaknesses in policy, regulation and service provision (GoK 2006). Coupled with donor pressure from international financial institutions such as the International Monetary Fund (IMF) and World Bank (WB), there was growing discontent from the public with the performance of the sector. Water sector reforms were aimed at addressing the weaknesses summarized in Table 2.1.The Water Act 2002 was enacted to remedy

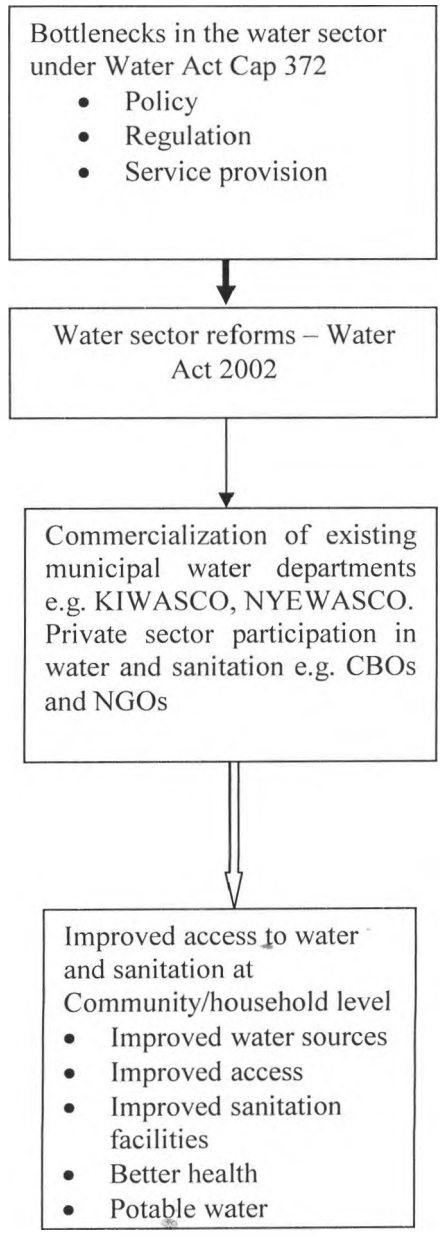
the sector's long negative trend with a view of improving efficiency in the delivery of water and sanitation services (GoK 2007).The Water Act 2002 has seen Kenya commercialize its water sector (Figure 2.1).

Table 2.1: Bottlenecks in the Water Act Cap 372

Policy formulation	• Poor co-ordination in the sector • Poor attention to the water resources management
Regulation	• Lack of clear regulatory framework • Lack of monitoring and evaluation • Poor performance of the water service providers
Service provision	• Poor management of water services • Failure to attract and retain skilled manpower • Inadequate allocation of resources • Poor, inefficient and unreliable service delivery • Low coverage of water supply and sewerage services • Inability to attract investments • Dilapidated water supply and sewerage infrastructure • High levels of unaccounted for water • Low revenue collection,

Source: GoK 2006

Figure 2.1: Conceptual framework



CHAPTER THREE: METHODOLOGY

3.0 Introduction

This study is on the effect of water interventions on the urban poor: An analysis of the Wandiege Community Water Supply Project in Manyatta B. The study compared three settings: where a water intervention availed piped water to household (Wandiege Connected); where a water intervention availed water through water kiosks (Wandiege Unconnected) and where there were no water interventions at all (Bandani).

3.1 Sources and Methods of Data Collection

The study utilized both primary and secondary data to achieve its three specific objectives. Primary data was collected from the 10th of November 2009 to 25th of November 2009. It entailed the following procedures:

1. Direct field observations were made by the researcher and were recorded using a field note book and a camera.

2. Personal interviews of selected households using a standardized pre-coded questionnaire.

3. Focus group discussions (FGDs) with the officials of the Wandiege Project

4. Informal interview with relevant personalities, individuals and organizations. These were: Zonal Manager KIWASCO; Corporate Communications and Public Relations Manager KIWASCO; Commercial Manager KIWASCO; Programme Officer for Water, Sanitation and Environmental Health in Pandpieri; Chief Public Health Officer Municipal Council of Kisumu; Nursing Officer in Charge of Primary Health Care, Kisumu Municipality; and water kiosk owners.

5. Collection of water samples for water quality analysis. Samples were collected at point of source i.e. For Wandiege Connected and Wandiege Unconnected, samples were drawn from the Wandiege borehole and Nyamasaria River. For Bandani households, samples were drawn from: Soko Kogweno unprotected spring; a protected shallow well within the

compound of the Mosque in Bandani; and from an unprotected spring near both the Cocacola Company and Kissat Bridge.

Secondary data collection involved reviewing and using existing of literature pertinent to the study, government publications and maps relevant to the study problem.

3.2: Sampling Procedures

3.2.1: Purposive Sampling (Wandiege Connected and Wandiege Unconnected Households).

The Wandiege Project is located in Manyatta B sub location. Manyatta has a population of 28,590 GoK (1999) & Maoulidi (2010). At the time of this study, Wandiege Community Water Supply Project had 112 water connections (91 households, 4 institutions and 17 water kiosks). The study had originally intended to sample 60 households in Wandiege (30 connected and 30 unconnected) and another 60 households in Bandani. Connected households (Wandiege Connected) had individual pipe water connections while unconnected households (Wandiege Unconnected) obtained water mainly from water kiosks within the Wandiege Project. The rationale for separating the connected and unconnected households was to measure the level of accessibility of water between the two. Bandani was considered so as to draw a larger picture of accessibility of water among households that have no water interventions at all.

All individual pipe water connections were served by a water meter housed inside a meter chamber. Each meter chamber had up to 10 water meters in it. Wandiege had 35 meter chambers at the time of this study. One of the Wandiege officials acted as our guide and helped in pin pointing these meter chambers. From 29 different meter chambers, 29 connected households were picked. Wandiege Unconnected households were picked adjacent to the 29 connected households. These were 34. Wandiege Connected had a sample of 29 households and while Wandiege Unconnected had a sample of 34 households, thus a total of 63 households in Wandiege.

3.2.2: Bandani

Bandani had a population of 9,571 GoK (1999) & Maoulidi (2010). The local area chief acted as our guide and helped to understand the settlement pattern. The chief accompanied the researchers for a guided tour of Bandani prior to the sampling. In this tour, the researchers observed a clustered settlement pattern. It also emerged that although Bandani was a large informal settlement, all areas are not equally populated. The sampling was concentrated on the densely populated area in which two households were randomly picked from each cluster. A sample of 60 households was drawn.

The study in total interviewed 123 households - 63 in Wandiege and 60 in Bandani. The standardized pre-set questionnaire was administered to the selected households. The questionnaire captured data on the following aspects: households' demographic characteristics (2009); household head migration history as at the time of the interview; households' access to water and sanitation; access to water and households' health; cost of water; households' perceptions on cost of water; regularity of the main water source; house conditions and other amenities. In order to understand the role of Wandiege Community Water Supply Project, households served by the Project (Wandiege Connected and Wandiege Unconnected) had an additional set of questions aimed at assessing the effect the project had on them (See Questionnaire in Appendix 1).

3.3: The Preferred Respondent

The preferred respondent for the household was the female household head. This was based on the assumption that the female household head was well versed with the dynamics and determinants of household water sources and uses as well as measures employed by households to cope with water shortage. In most cases (84%), the female household head was interviewed. In the event that the female spouse was not available, the male household head or another adult household member was interviewed.

3.4: Water Quality Sampling

Water quality sampling was carried out after all the 123 household interviews had been conducted. This was important as during the interviews, the researchers had been asking questions on households' main sources of water. These questions served as a pointer to the main water sources that should be sampled. From their well versed knowledge of our study area and sampled households, our guides verified that the main water sources reported by the households were the ones from which they actually obtained water from mostly.

The study relied on the expertise of the laboratory staff from Lake Victoria South Water Services Board (LVSWSB) for the collection of water samples and subsequent analysis. The experts, accompanied by the researchers, collected water samples and delivered them to LVSWSB laboratory in Nyalenda within 30 minutes of collection, according to water collection sampling procedures.

3.5: Human Welfare Index (HWI)

In order to place a value on the households' welfare, the study computed the HWI based on whether the households had household items such as cell phone, radio, gas, a television set, fridge, gas cooker, motor cycle and a bicycle. The study placed a value on the household items as follows:

Radio = 1

Cell phone = 2

Gas cooker = 3

Tv = 6

Bicycle = 10

Fridge = 12

Motor cycle = 16

For example, the cost of a gas cooker was three times that of a radio. The minimum score was 0 which meant that the household possessed none of the items while the maximum score was 50 which meant that the household possessed all items. The HWI was computed as follows:

1. Frequencies were generated for all household items
2. From the frequency scores, class intervals were created.
3. An average HWI was created for each area by computing the mid values for each class, then multiplying by the frequency scores
4. The result was then divided by the total frequency in each area to get the HWI.

3.6: Data Processing and Analysis

In data analysis, all variables were first subjected to frequency analysis as an exploratory measure of distribution tendencies. The distribution tendencies in tabulation and graphical display formats were used to provide accurate description of the sample data. After studying and understanding the distribution tendencies, there was need to test whether there were differences or similarities in the access to water and sanitation among the Wandiege Connected, Wandiege Unconnected and Bandani households. The appropriate test was selected: non – parametric Spearman's Rank Correlation. The Spearman's Rank correlation was used as a measure of association of different parameters. To compute the correlation coefficient *r,* the study used the formula:

Spearman's coefficient of correlation $(r_s) = 1 - \left[\frac{6\sum d_i^2}{n(n^2-1)}\right]$

Where n = number of paired observations

d_i = the difference in ranks for each paired observation

Significance was at $\alpha = 0.05$ (95% confidence level).

CHAPTER FOUR: RESULTS AND DISCUSSION

4.0 Introduction

This chapter is organized in three parts. The first is a description of the Wandiege Project, the second is on access to water and sanitation among the Wandiege Connected, Wandiege Unconnected and Bandani households. The third section is on the effect of the Wandiege Project on the livelihoods of the community it served.

4.1 The Wandiege Project

This section on Wandiege Community Water Supply Project is based on a focus group discussion (FGD) with the officials of Wandiege in November 10th 2009 held at the project site in Wandiege primary school. (See photo 4.1: Photograph of FGD with Wandiege officials and on the left, the Wandiege office).

Photo 4.1: FGD with Wandiege officials and the Wandiege office (left)

Source: Fieldwork 2009

The Wandiege Project is located in Wandiege primary school in Manyatta B. Several persons made the Wandiege Project a reality. These were the community members, a local NGO by the name Sustainable Aid in Africa International (SANA) which implemented the project and several donors like French Agency for Development (AFD), an NGO (CORDAID) and the Constituency Development Fund (CDF). Wandiege came to be in the year 2001 following an assessment of priority needs for its community members by AFD. The households in this part of Manyatta B identified improved access to water as their main priority. A local NGO by the name (SANA) then helped the community members to draft a proposal geared toward the objective of improving their access to water and sanitation. (SANA works in informal settlements of Kisumu mainly to improve access to water and sanitation).

The proposal entailed the following options: laying out of a 5 Km pipe network, buying a water pump, drilling a borehole, securing an electricity connection, purchasing a reservoir tank as well as erecting an elevated structure on which the reservoir tank would be raised. The AFD drilled a borehole and also donated money for bricks and slabs to be used for protecting the borehole. As of 2003, AFD had achieved the objective of drilling the community borehole. AFD then left the community to carry forward the project. However, community members were determined to 'take water to their doorsteps'. The proposal that had been previously drafted was then tabled to various NGOs in the water and sanitation sector. In early 2005, the proposal attracted a donor CORDAID (a Dutch NGO that also plays a leading role in water supply and sanitation). CORDAID proposed a total of Ksh. 3 million to execute the rest of the proposal. Of the proposed Ksh. 3 million, CORDAID donated Ksh. 2 million. This left the community members with the challenge of raising Ksh. 1 million.

In order to raise the Ksh. 1 million, the community members came up with a formula: each person willing to form part of the water supply project from the community would purchase shares worth Ksh. 1000 to raise the 1 million. The share price was fixed at Ksh. 200 so that five shares could raise Ksh. 1000 per person. As some of the community members could not afford to buy the shares in cash, there was an option to buy shares in kind by taking part in building water kiosks, digging trenches and laying pipes for the Wandiege water supply pipe network. A day of

work in the project site was equivalent to one share. Altogether, 300 people bought shares in cash or in kind. The Ksh. 1 million target had not been achieved.

In order to attain the Ksh. 1 million target, the community appealed to both local and central governments to contribute to the project. Although both the local and central government had pledged Ksh. 500,000, the pledges were not honored. Ultimately, the community obtained Ksh. 500,000 from the Constituency Development Fund (CDF). As of 2006, there were already 7 water kiosks, but without piped water connections to individual households. At the time of this study in November 2009, the Project had 112 water connections (91 households, 4 institutions and 17 water kiosks).

4.1.1: The Operation of Wandiege

Wandiege is registered with Lake Victoria South Water Services Board (LVSWSB) as an independent water service provider. Wandiege sets up its own tariff structure and operates on a non- profit basis. Revenue for Wandiege comes from monthly bills paid by water kiosk owners and households connected to the Wandiege water supply network. The revenue raised from the project is injected back to the project so as to cover its operation and maintenance costs. The rest of the revenue is employed to expand water supply coverage.

The project's water is abstracted from the Wandiege borehole. The water supply is organized such that from the borehole, water is pumped into two elevated reservoir tanks each with a capacity of 10,000 liters. From the reservoir tanks, water flows to water meters aided by gravity. The system relies on electricity for pumping water. At the time of this study, the Wandiege water supply coverage was serving about a 5 square kilometer radius (about 10,000 persons).

Wandiege is managed by board members who have been involved in the project since its inception. The time of this study, the management board was composed of: a chairperson, a vice chairperson, a task force member, a treasurer, a representative of water kiosk attendants, a secretary, an assistant secretary and a member of the neighborhood association. The management board operates on a voluntary basis, although occasionally, they receive a token of appreciation for their services to the Wandiege Project. The logic behind this management team was that it is

well versed with the project's background, implementation and operational aspects. The board members make decisions for example regarding the expansion of the pipe network to households or water kiosks. The board members are assisted by task force members. A task force is a group of community members who are charged with the responsibility of finding solutions to specific problems emerging in the community. There are task forces on solid waste management and sanitation.

4.1.2 Challenges Facing Wandiege

1. Lack of Understanding and Suspicion

Since its inception, Wandiege has not paid any dividends to its shareholders. Some shareholders do not understand why dividends have not been forthcoming. In describing the demand for dividends by these shareholders, the assistant secretary remarked that it was like "demanding rent from a house that was still under construction". Some shareholders also lacked a good understanding of the operation of the project. For example, they did not understand why they needed to buy shares as the project had already attracted donors such the AFD and CORDAID. As such, there was suspicion as to how the officials managed the project.

Another example of lack of understanding was concerning the location of water kiosks. Wandiege had water kiosks set up for the benefit of community members who did not have the financial capacity to secure a water connection to their households. These water kiosks were owned and managed by Wandiege. Wandiege officials had approached some community members so as to permit them to put up water kiosks. Indeed, some community members agreed and the water kiosks were put up. However, when the land owners understood that the kiosks were meant to serve community members, they demanded that the kiosks be uprooted. The kiosks were uprooted. Wandiege had to find other persons willing to have Wandiege water kiosks on their land. Wandiege also incurred the expense of setting up new water kiosks.

2. Financial Constraints.

Wandiege also faced financial problems that affected its efficient operations and curtailed its progress, for example, inflation. When the project started in 2001, a tap costed Ksh. 150, a gate

valve costed Ksh. 750 while a lorry of sand costed Ksh. 1800. At the time of this study, the officials informed us that the prices of a tap, gate valve and a lorry of sand were Ksh. 550, Ksh.1500 and Ksh.3350 respectively. In other words, it had become more expensive to maintain its network and expand its coverage. Wandiege also lacks land for expansion as the Wandiege primary school compound where the project is situated is very small. In addition, the cost of conducting water quality analysis for the borehole was prohibitive, so the quality of the borehole water was not tested frequently. The officials informed us that water quality testing was done only once when the borehole was drilled. The project has also had a financial setback of replacing vandalized items from its water supply network. For example, Ksh. 35,000 was spent on purchasing new water meters following incidences of theft and vandalism.

The project has not been able to purchase reservoir tanks because of lack of funds. Reservoir tanks were meant to cushion community members from water shortage when there were power cuts which prohibit pumping water to households. In addition, Wandiege would have wished to have a stand- by generator to pump water during power cuts but the cost of a generator was beyond the reach of the project. The officials mentioned that some of the community members did not pay their bills. The Wandiege Project officials were also of the opinion that their revenues should not be taxed as they are availing a social good (water) to the community.

4.1.3: Wandiege's Future Plans

1) Training Office Staff and Purchase of Office Equipment

Plans were underway to purchase a computer to make processing of bills easier and faster. At the time of this study, bills were being processed manually by one revenue clerk. The possibility of more acquiring office space was being explored as the office in use was very small. There were also plans to train the management team as well as bringing in more people on the management board.

2) Expansion of Water Supply Coverage

At the time of this study, one of the local banks (K-Rep) had been approached for a loan to facilitate the expansion of the water supply coverage. Wandiege had the target of expanding its water supply to serve the entire population of Manyatta B, approximately (30,000 persons). The project was also set to provide water to the neighbouring upper Kanyakwar which would involve drilling another borehole. There were exchange visits between the officials of Wandiege and persons from Obunga, South West Kisumu and Manyatta A who had also expressed interest in the water services rendered by Wandiege. Another proposal was underway to be tabled to CORDAID. The proposal was meant to accommodate persons who would have liked to make a water connection to their households but lacked the requisite financial capacity. The arrangement would be such that after getting a water connection, the person incurred a fee in their monthly bill, spread out until the water connection charges are fully paid up.

4.2 Characteristics of the Sampled Households

As mentioned earlier, throughout, the study compared 3 sets of households. Those with individual piped water into their homes (Wandiege Connected); those without individual piped water but had access to water mainly from Wandiege water kiosks (Wandiege Unconnected) and households that had not experienced any water interventions at all (Bandani). Water for Wandiege Connected and Wandiege Unconnected households was from the Wandiege Community Water Supply Project. The unit of analysis was the household.

The study noted that sampled households were almost identical in size. The mean household sizes were as follows: Wandiege Connected 4.7; Wandiege Unconnected 4.5 and Bandani 4.9. All households had a higher percentage of females than males. The study also found that most household members had attained some formal education. Less than a fifth of the household members lacked formal education. Majority of household members in the 3 settings worked in their own Household Micro Enterprises (HMEs). As earlier mentioned, the preferred respondent for the households was the female household head. The study interviewed 84% female household heads. Although the rest of the questionnaires were addressed by the male household head, the

study found no significant gender differences in the responses. Table 4.1 shows the characteristics of sampled households.

Table 4.1: Characteristics of sampled households (%)

Household Profile	Wandiege		Bandani
	Connected N=135	Unconnected N=155	N=291
Household head	18.7	20.6	19.6
Spouse	15.8	13.5	10.3
Son/daughter	48.9	59.4	56.4
Brother/sister	4.3	0.6	3.1
Father/mother	0.7	0	0
Other relative	7.2	5.2	1.0
Non-relative	4.3	0.6	0.7
Total	**100**	**100**	**100**

Source: Fieldwork 2009.

4.3 Households' Migration and Settlement.

The study established migration and settlement patterns of the household heads since they came to Kisumu (Table 4.2 gives a summary of the migration history of the household heads). Some of the household heads in Bandani seemed to have had a longer integration in Kisumu and in the informal settlement as opposed to Wandiege household heads. For example, about one-fifth of the Bandani household heads came to Kisumu between 1930 and 1970, while about two-fifths had stayed in the settlement prior to the 1990s. As far as residential mobility is concerned, 41.4% of Wandiege Connected households had stayed in other estates as compared to 32.4% and 25% of Wandiege Unconnected and Bandani households. For those who had ever resided elsewhere, it was more likely that they lived in another informal settlement (i.e. Nyalenda, Obunga and Manyatta A).

Table 4.2: Migration history of the household heads

	Year the household head came to Kisumu (%)			Year the household head came to the informal settlement (%)		
	Wandiege		Bandani	Wandiege		Bandani
	Connected	Unconnected		Connected	Unconnected	
	N=29	N=34	N=60	N=29	N=34	N=60
Before 1970	10.3	14.7	22	10.3	11.8	18.3
1971-1979	20.7	5.9	5.1	3.5	5.8	6.7
1980-1989	17.3	17.6	15	3.4	8.9	13.3
1990-1999	34.5	20.6	11.7	38	23.5	11.7
2000-2009	17.5	41.2	46.6	44.8	50	50
Total	**100**	**100**	**100**	**100**	**100**	**100**

Source: Fieldwork 2009

4.4 Household Welfare

More than a half of Wandiege Connected (69%) and Wandiege Unconnected (52%) households owned the houses they lived in as compared to about a quarter (35%) of the Bandani households. In terms of housing quality, the roof material was predominantly corrugated iron sheet, although Bandani had a few houses using tins (8.3%) and a grass thatched roofs (1.7%). Wall materials for Wandiege Connected households were slightly better than those of Wandiege Unconnected and those of Bandani. For example, 13.8% of Wandiege Connected households had mud walls as compared to 29.4% and 26.7% for Wandiege Unconnected and Bandani households respectively.

During the interviews, households were asked to state their monthly income. Due to the sensitivity of household or personal financial issues, four income brackets were used (Table 4.3) and the households were asked which income bracket they fell into. Respondents tend to underestimate their incomes when given in absolute values. In some cases, the income brackets cushion those who may be shy to give their actual income (Ratchford, Lee & Talukdar 2003). The study found that Wandiege Connected households had the highest HWI (19.8). Wandiege Unconnected and Bandani households had HWIs of 8.1 and 8.5 respectively.

Table 4.3: Household Income

Income Bracket	Wandiege Connected N=29	Wandiege Unconnected N=34	Bandani N=60
up to 5,000	6.9	12.1	16.9
5,001-10,000	27.6	57.6	49.2
10,001-20,000	27.6	27.3	30.5
more than 20,000	37.9	3.0	3.4
TOTAL	**100**	**100**	**100**

Source: Fieldwork 2009

Table 4.4: Household Welfare Index

Household items (Frequencies)	Wandiege Connected N=29	Value of household items	Wandiege Unconnected N=34	Value of household items	Bandani N=60	Value of household items
Cell phone	24	48	28	56	47	94
Redio	25	25	27	27	38	38
Tv	23	138	9	54	18	108
Gas Cooker	15	45	2	6	4	12
Fridge	16	192	-	0	2	24
Bicycle	11	110	10	100	22	220
Motor cycle	1	16	2	32	1	16
TOTAL		**574**		**275**		**512**
Average HWI		**19.8**		**8.1**		**8.5**

Source: Fieldwork 2009

4.5 Households' Access to Water

In order to determine accessibility of water by households, the study had recourse to a number of parameters: sources of water; uses of water; cost of water; perceptions on various sources of water in terms of safety for drinking; actual water quality assessment of households' main water sources; quantities of water available for the household per day; per capita water consumption; time taken to fetch water in one full cycle; perception on the cost of water; monthly average cost of water, persons in the household responsible for fetching water; incidences of water shortage; alternative sources of water during shortages; and mitigation measures employed to cope with water shortage.

4.5.1 Main Sources of Water.

The study identified households' main sources of water: individual piped water; piped water from landlord or neighbour; piped water from a public stand pipe or a water kiosk; roof catchment; private water vendors and surface water. All sources of water labeled as 'piped water' were from the Wandiege Community Water Supply Project borehole in Wandiege. The most important source of water for Wandiege Connected households was individual piped water for 29 households (100%). Both Bandani and Wandiege Unconnected households had no access to individual piped water. For Wandiege Unconnected households, there were two main sources of water: piped water from water kiosks and from their neighbours. In Bandani, the main sources of water were surface water and private water vendors (Table 4.5).

Table 4.5: Households' main sources of water (%)

	Wandiege		Bandani
	Connected	Unconnected	
	N=29	N=34	N=60
Piped water (Individual)	100	-	-
Piped water (Landlord's)	-	2.9	-
Piped water (neighbour's)	-	23.5	-
Piped water (public stand pipe & Kiosks)	-	67.6	-
Roof catchment	-	5.9	0
Shallow wells	-	0	6.6
Private water vendors		-	23.3
Surface water		-	70.0
TOTAL	100	100	100

Source: Fieldwork 2009

4.5.2 Water Collection Time

As would be expected, the location of a water source has an influence on the amount of time involved in its collection. For example, all 29 households in Wandiege (Wandiege Connected) had an individual water connection to their houses. These households spent a maximum of 7 minutes on water collection (full cycle) as compared to Wandiege Unconnected (31 minutes) and Bandani (42 minutes full cycle). In addition to time involved in water collection, close proximity to a water source may afford households more quantities of water for domestic use. For instance, average household water consumption for Wandiege Connected households was 135 liters per

day and 116 liters per day for Wandiege Unconnected households. In Bandani, daily average household water consumption was 98 liters. The per capita water consumption for Wandiege Connected was 28.7 liters as compared to 24.7 liters among Wandiege Unconnected and 20.4 liters among the Bandani households. For off plot water sources, the water collection tasks fell mainly on the adult females in the household (50% for Wandiege Unconnected and 55% for Bandani).

4.5.3 Regularity of Household's Main Water Source

Households were asked to give an indication of the regularity of their main water source. Most of the main water sources were regular. However, more than a half of the households had experienced water shortages from the year 2008 to November 2009 at the time of this study. Wandiege households (both Connected and Unconnected) experienced water shortages on account blackouts, during which there was no electricity to pump water to the households. These shortages were reported to persist for a period between a week to a month during which households had to rely on alternative water sources. Bandani households on the other hand had to fetch water from springs further from their homes when the ones nearby either dried up or had a little volume of water. Alternative sources of water were shallow wells, surface water and water vendors. There was heavy reliance on surface water during shortages by all households. Surface water for both Wandiege Connected and Wandiege Unconnected households was from the nearby Nyamasaria River (Table 4.6).

Table 4.6: Alternative sources of water (%)

	Wandiege		**Bandani**
	Connected N=17	**Unconnected N=27**	**N=30**
Water vendors	-	-	10
Surface water	94.2	96.3	90
Shallow wells	5.8	3.7	-
TOTAL	**100**	**100**	**100**

Source: Fieldwork 2009

Periods of water shortage inconvenienced households in three ways: one, they had to spent more time in search of water or two, they had to spent more money on water or three; they had to spent more time in search for water but also spent more money on water. Naturally, water shortage periods may require some sort of measures to be employed so as to cope with the situation. More than 90% of all sampled households resorted to reduced water consumption. Less than 10% of the households utilized a water reservoir (Table 4.7)

Table 4.7: Effect of water shortage on the household: coping with shortage (%)

Effect of water shortage	**Wandiege**		**Bandani**
	Connected	**Unconnected**	
	N=17	**N=29**	**N=31**
Water is expensive	60	21.4	6.9
Spent a lot of time to fetch water	6.7	14.3	27.6
Spent a lot of time and money on water	33.3	64.3	65.5
TOTAL	**100**	**100**	**100**
Coping with water shortage	**N=16**	**N=27**	**N=22**
Reduced consumption	93.8	92.6	100
Utilized water reservoir	6.2	7.4	-
TOTAL	**100**	**100**	**100**

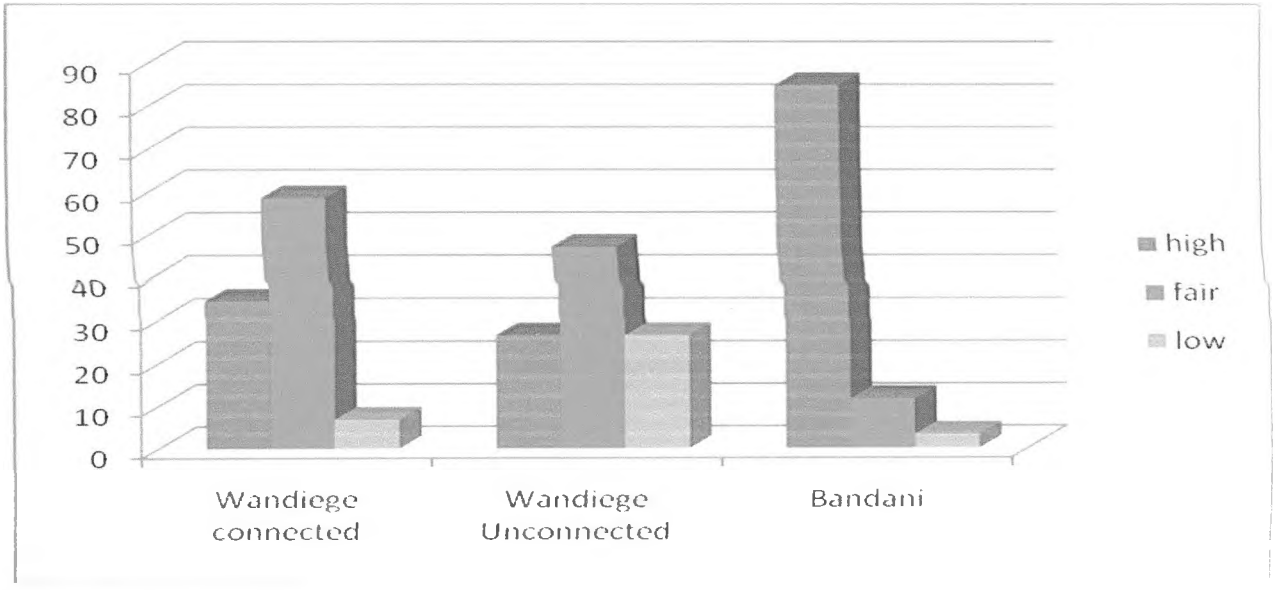
Source: Fieldwork 2009

4.5.4 Price of Water

Generally, the scarcity of commodities in the market causes price hikes. Water is no exception to this rule. For example, Wandiege had more physical infrastructure for water supply as compared to Bandani. It would be correct therefore to expect water to cost more in Bandani. Take for instance the average monthly cost of water. The study found this to be Ksh. 512, Ksh. 503 and Ksh.716 for Wandiege Connected, Wandiege Unconnected and Bandani households respectively. Although Bandani households relied largely on surface water, they incurred the highest water bill as compared to Wandiege Connected and Wandiege Unconnected households. This meant that they had to purchase water from vendors to augment the surface water sources. Reliance on water vendors was attributed to long hours spent at the surface water sources – eight hours or more and squabbles at the surface water sources, especially during water shortage spells.

The study also sought to understand what perceptions the households had as far as the prices paid for water were concerned. Households were asked to rate the prices as high, fair or low. The study found that the price of water was perceived as high for 34.5%, 26.5% and 85% of Wandiege Connected, Wandiege Unconnected and Bandani households respectively.

Figure 4.1: Households' perceptions on cost of water



Source: Fieldwork 2009

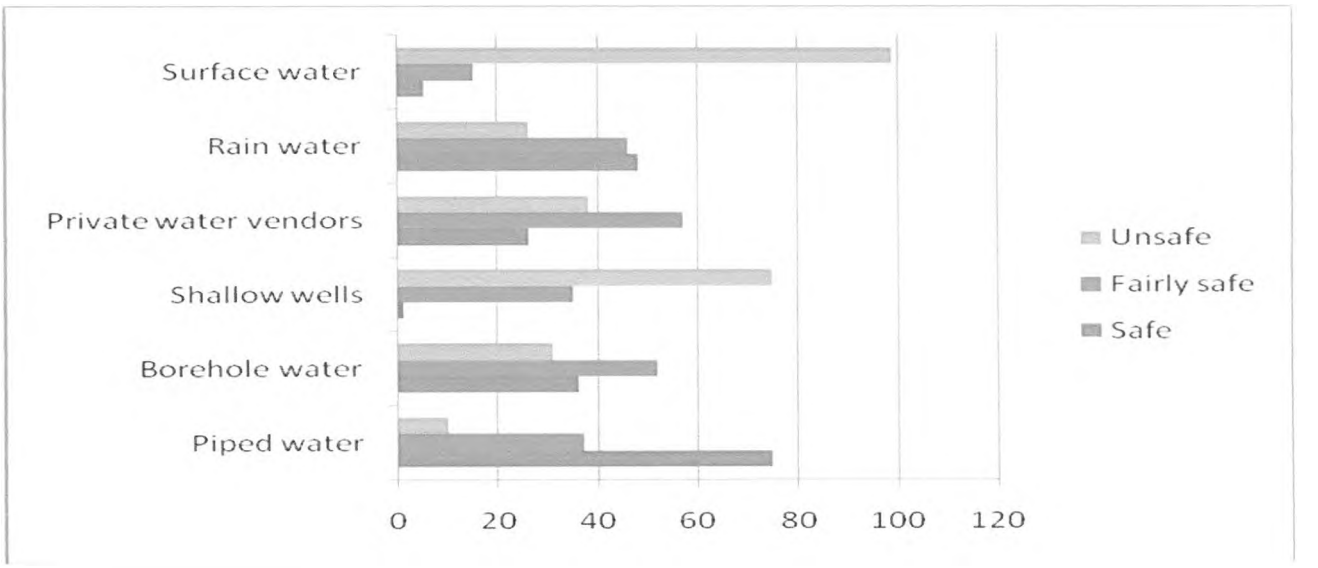
4.5.5 Households' Safety Perceptions on Various Drinking Water Sources

Households were asked a question concerning their perception on the safety of different water sources for drinking. This was regardless of whether they had access to the source or not. This question was considered as a pointer to the households preferred drinking water sources. Different water sources were rated as good, fair or low. The analysis was done for all 123 sampled households.

It was interesting that 60% (75) households perceived piped water as safe. This finding suggested that households would desire piped water for drinking. Only 10 households (8.1%) thought that piped water was unsafe. Findings on surface water were remarkable. Only 4% (5 households) perceived surface water as safe. A vast majority 80% (99 households) perceived it as unsafe. The study also established a stark finding on water from shallow wells. Only one

household (0.8%) perceived it as safe. Consensus converged on the perceived unsuitability of surface water and water from shallow well water for drinking (Figure 4.2).

Figure 4.2: Households' perceptions on various drinking water sources



Source: Fieldwork, 2009

4.5.6 General Water Safety Perceptions and Actual Water Quality

The study sought to understand how the households perceived the safety of water from their main source. Households were asked to give a rating of their main water source in terms of quality, by indicating whether it was safe, fairly safe or unsafe. Wandiege Connected households were more confident about the quality of their main water source (75.9%) as compared to Wandiege Unconnected and Bandani (70.6% and 55%) respectively. Less than a tenth of the households perceived their main water source as unsafe.

Apart from the rating of water quality by the households, the study undertook microbacteriological water quality analysis for an objective judgment of water quality for domestic consumption, especially for drinking (Box 4.1). As earlier indicated, the sampling was done at point of source. Results showed that the only potable source of water was the Wandiege borehole. All other water sources were not potable on account of severe contamination by faecal coli forms (Table 4.8. See also appendix 2 for detailed water quality analysis results).

Table 4.8: Water Quality Analysis Results

Site	Total coli form count	Faecal coli form count	Comment
Wandiege project borehole	1cfu**/100 ml	Nil/100 ml	Potable
Nyamasaria River	TNTC*/100 ml	TNTC*/100ml	Not potable
Bandani protected spring (Soko Kogweno)	98cfu**/100 ml	489cfu**/100 ml	Not potable
Unprotected spring (Kissat Bridge & Cocacola co.)	TNTC*/100 ml	TNTC*/100ml	Not potable
Protected shallow well (Bandani Mosque)	TNTC*/100 ml	TNTC*/100ml	Not potable

Source: Fieldwork 2009 *TNTC-Too Numerous To Count: **CFU- Coli form Forming Unit

Box 4.1: Microbiological Analysis of Drinking Water

The most common and widespread health risk associated with drinking water is contamination; whether directly or indirectly, by human or animal excreta, particularly human excreta. If such contamination is recent, and if those responsible for it include carriers of communicable enteric diseases, some of the pathogenic microorganisms that cause these diseases may be present in water. Drinking the water or using it in food preparation may then result in new cases of infection. The pathogenic agents involved include bacteria, viruses, and protozoa, which may cause diseases that vary in severity from mild gastroenteritis to severe and sometimes fatal diarrhoea, dysentery, hepatitis or typhoid fever. Faecal contamination of drinking water is only one of the several faeco-oral mechanisms by which they can be transmitted from one person to another, or in some cases, from animals to people.
Ideally, all samples taken from the distribution system including consumers' premises should be free from coli form organisms. In practice, this is not always attainable. To control purity of water, the following microbiological parameters for water collected in the distribution system are therefore recommended:
1) No sample should contain E.Coli in 100ml
2) No sample should contain more than 10 coli form organisms per 100ml
3) Coli form organisms should not be detectable in 100ml of any two consecutive samples
4) Throughout any year, 95% of samples should not contain any coli form organisms in 100ml

The coli form group has been used as an indicator of the bacteriological safety of water. The coli form group merits consideration as an indicator of pollution/ contamination because these bacteria are always present in intestinal tracts of humans and other warm blooded animals and are excreted in large numbers in faecal wastes. Although the sanitary significance of some coli form strains is questionable, all members of the group may be of faecal origin, and it should be assumed that they are of faecal origin unless it can be proven otherwise. As water is not the natural medium for coli form organisms, their presence must at least be regarded as indicative of contamination.

Source: http://www.auroville.info/ACUR/documents/laboratory/report_microbiological_tests accessed 14th July 2011, 10.30p.m

4.5.7 Uses of Water

The study noted that households used different sources of water for different purposes, perhaps depending on the perceived safety of the water source in question (Table 4.9). It was also noted that all water sources had multiple uses such as cooking, drinking and washing. The study went further to find out how households were making their water safe for drinking. The study found that 29.6%, 25.9% and 44.4% of

Wandiege Connected, Wandiege Unconnected and Bandani households respectively treated their water (Table 4.10). On average, water treatment costs for the households per month were Ksh 148, Ksh. 75 and Ksh.59 for Wandiege Connected, Wandiege Unconnected and Bandani households respectively.

Table 4.9: Uses of various sources of water (%)

Piped water	**Wandiege**		**Bandani**
	Connected N=52	**Unconnected N=46**	**N=63**
Drinking	13.8	4.3	-
Washing	3.4	2.2	-
Cooking	13.8	6.5	-
Drinking/washing/cooking	20.6	2.2	-
Shallow well water			
Drinking	1.8	-	1.7
Washing	1.8	2.2	3.2
Cooking	-	2.2	3.2
Drinking/washing/cooking	-	2.2	7.9
Private water vendors			
Drinking	17.2	15.2	-
Washing	-	-	-
Cooking	3.4	-	-
Drinking/washing/cooking	3.4	2.2	6.3
Water Kiosks			
Drinking	6.9	-	-
Washing	-	4.3	-
Cooking	3.4	8.9	-
Drinking/washing/cooking	-	30.4	-
Rain Water			
Drinking	1.8	2.2	-
Washing	-	2.2	-
Cooking	-	-	-
Drinking/washing/cooking	5.1	13	3.2
Surface Water			
Drinking	-	-	4.7
Washing	3.4	-	3.2
Cooking	-	-	6.3
Drinking/washing/cooking	-	-	60.3
TOTAL	**100**	**100**	**100**

Source: Fieldwork 2009

Table 4.10: Does this household treat water (YES) (%)

Source of Water	Wandiege		Bandani
	Connected N=24	Unconnected N=21	N=36
Piped water	29.2	4.8	-
Water Kiosk	-	61.9	-
Shallow wells	8.3	9.5	16.7
Private water vendors	37.5	19	8.3
Roof catchment	16.7	4.8	-
Surface water	8.3	-	75
Total	**100**	**100**	**100**

Source: Fieldwork 2009

4.5.8 Households' Health

The study also sought to understand how the households' perceived risks in the event that a person drank unpotable water. The results revealed that almost all households (89.4%) were well aware of the risk of contracting a water borne disease. Some of the water borne diseases identified were cholera and typhoid fever. In spite of this knowledge, some households did not treat their water (Photo 4.2). In fact, some household members had contracted water borne diseases in the year 2008 to November 2009 at the time of this study. The reported disease incidences were not clinically proven but as merely reported by the households. Water borne diseases were more prevalent in Bandani (41.7%) as compared to 29.4% among Wandiege Unconnected households and 13.8% among the Wandiege Connected households.

Households had to incur some cost of treatment for these diseases. In the year 2008 to November 2009 at the time of this study, the average cost of treatment for the households was Ksh. 630 for Wandiege Connected, Ksh. 1101 for Wandiege Unconnected and Ksh. 2892 in Bandani. The study found that for the households where a person suffered from a water borne disease, there were three implications. One, the cost of treatment was high; two, the sick person could not report to school or work or three, the cost of treatment was high and the sick person could not report to school or work.

Photo 4.2: School girl drinks severely contaminated water at Soko Kogweno spring in Bandani

Source: Fieldwork 2009

In the light of these outcomes as far as household health is concerned, households were asked if they were willing to pay more money for a safe water supply. The study found that over a half of the households were willing to pay more for a safe supply of water: i.e. 55.2% of the Wandiege Connected households, 67.6% of the Wandiege Unconnected households and 76.7% of the Bandani households. Households were also asked what suggestions they had to improve their water supply. The responses were as in Table 4.11.

Table 4.11: Suggestions to improve water supply (%)

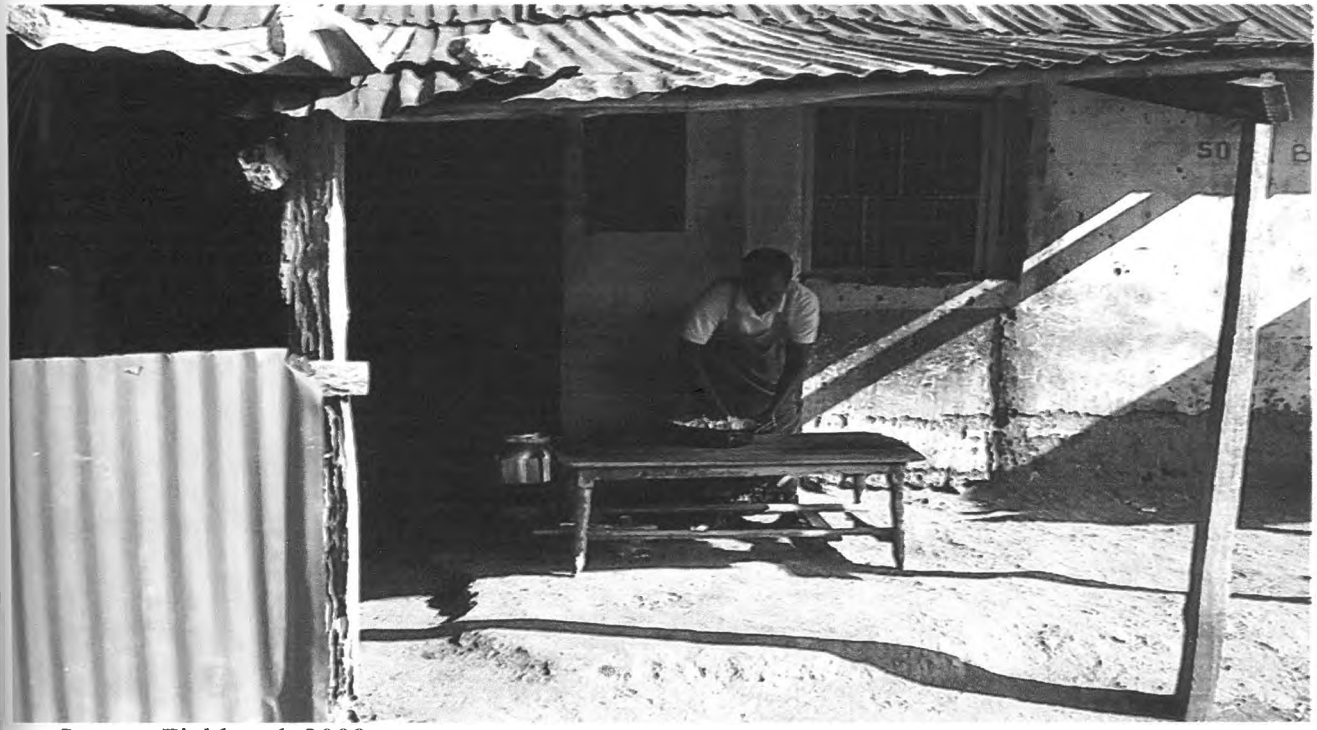
	Wandiege		Bandani
	Connected	Unconnected	
	N=24	N=27	N=44
Drill more boreholes	12.5	7.4	18.1
Reduce salinity of borehole water	20.8	-	27.2
Build more water kiosks	16.7	29.6	-
Maintain water pump/ have stand by hand pump	16.7	25.9	-
Treat water before distribution	25	7.4	-
Reduce the price of water	4.2	3.7	-
Maintain pipe network	4.2	25.9	-
Expand pipe water coverage to Bandani	-	-	38.6
Improve water quality in shallow wells	-	-	15.9
TOTAL	**100**	**100**	**100**

Source: Fieldwork 2009

4.5.9 Households' Livelihood Activities

The study sought to understand the importance of water on the livelihoods of the households. About a third of livelihood activities the three settings depended directly or indirectly on access to water i.e. 34% for Wandiege Connected, 35.3% for Wandiege Unconnected and 35% for Bandani. These activities were either small scale urban farming such as keeping chicken, livestock (Photo 4.4), a small vegetable garden or running a Household Micro Enterprise (HME) such as a road side food kiosk (Photo 4.3). Water shortage periods were reported to have had negative effects on livelihood activities. For instance, activities such as urban farming were adversely affected in that the crops dried up. HMEs such as road side food kiosks and water kiosks had little or no business activity.

Photo 4.3: Roadside food kiosk selling chapati and tea in Wandiege



Source: Fieldwork 2009

Photo 4.4: Urban Farming in Bandani - Chicken and cows in the background

Source: Fieldwork 2009

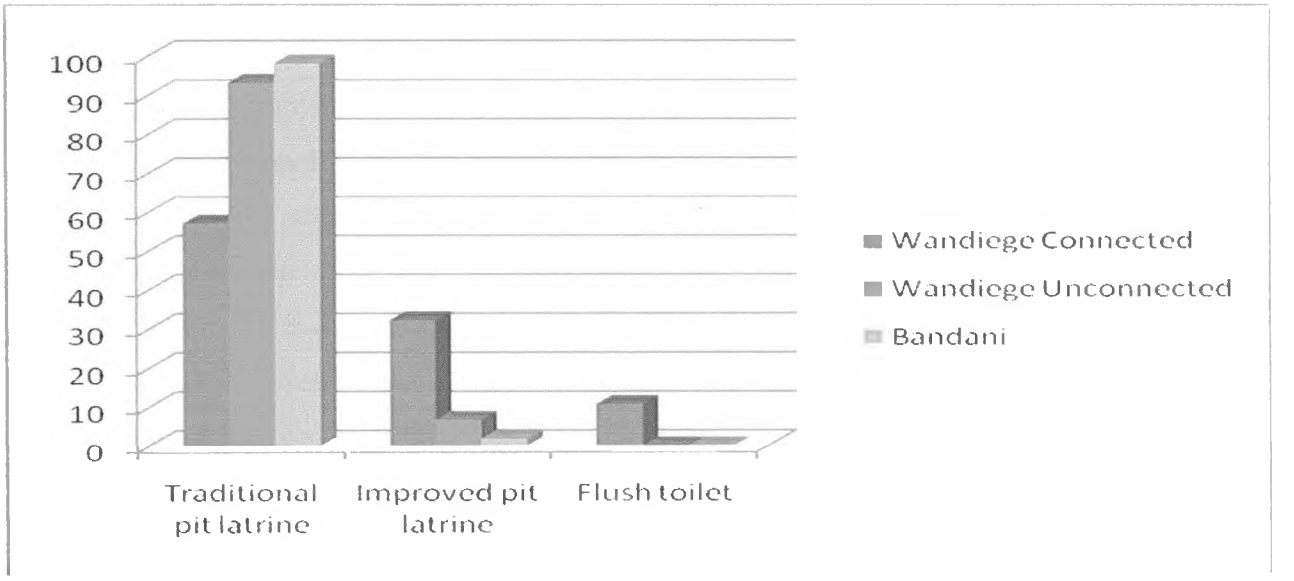
4.6: Access to Sanitation

In order to determine access to sanitation, the study made use of the following parameters: presence of a sanitation facility for use by households; type of sanitation facility; whether the sanitation facility was shared and by how many people; sensitization on use of sanitation facilities; the benefit of having a sanitation facility at household level; and whether there was any problem with the sanitation facility in use at the time of the study.

It was impressive that all but 2 households had access to a sanitation facility. One Unconnected Wandiege household and another in Bandani had no access to sanitation facilities. The predominant type of sanitation facility was the traditional pit latrine. However, there were more improved sanitation facilities among the Wandiege Connected households (42.9%) as compared to 6.6% among the Wandiege Unconnected households and 1.8% among the Bandani households. What was remarkable about sanitation facilities was the number of people sharing

one such facility. For example, there were 48 persons sharing one sanitation facility among the Wandiege Connected households as compared to 61 persons among Wandiege Unconnected households and 73 persons among Bandani households.

Figure 4.3: Type of sanitation facility (%)



Source: Fieldwork 2009

The study found that some form of sensitization took place with regard to use of sanitation facilities. For example, sensitization had been done for 41.4%, 35% and 20 % of the Wandiege Connected, Wandiege Unconnected and Bandani households respectively. It was undertaken by a variety of groups: CSOs; NGOs; Ministry of Health; and mass media. Some of the NGOs that carried out the sensitization included SANA, Kisumu Urban Apostolate Programme – Pandpieri (KUAP) and Aphia II Nyanza. Some of the CSOs that also did sensitization were Tuungane (Bandani), the Muslim community and Muungano wa Wanavijiji (Union of informal settlement dwellers). Sensitization efforts enlightened community members on proper use of sanitation facilities and on the importance of improved sanitation facilities. It was also geared toward hygiene promotion through practices such as hand washing.

The sanitation facilities were put up either by home owners or landlords (or SANA for some of the Wandiege Connected and Wandiege Unconnected households). SANA helped to put up improved sanitation facilities such as ecosanitation and sand-platform latrines. This initiative by SANA was aimed at overcoming the obstacle of collapsing pit latrines in the rainy season. The collapse of pit latrines was attributed to poor soil structures in Kisumu. The initiative by SANA saw the construction of nine improved sanitation facilities for Wandiege Connected households and two for the Wandiege Unconnected households. The Wandiege Connected and Wandiege Unconnected households indicated that on account of access to sanitation facilities, there were better hygiene standards and less water borne disease outbreaks. Bandani households did not indicate any benefits accruing to them on account of access to sanitation facilities (Photos 4.5 & 4.6). Households were also asked whether there was a problem with the sanitation facility that they were using at the time of this study in November 2009. Some of the problems cited were that the pit latrines filled up fast as they were shallow; pit latrines sank in the rainy season or that there were too many people were sharing one facility.

Photo 4.5: Pit latrine wall beginning to crack near the ground in Wandiege

Source: Fieldwork 2009

Photo 4.6: A collapsed pit latrine in Wandiege

Source: Fieldwork 2009

4.7: Effect of the Water Interventions

This section is drawn from some of the emerging impacts of the Wandiege Project water intervention. Table 4.12 presents a summary of the effects of water interventions at a glance.

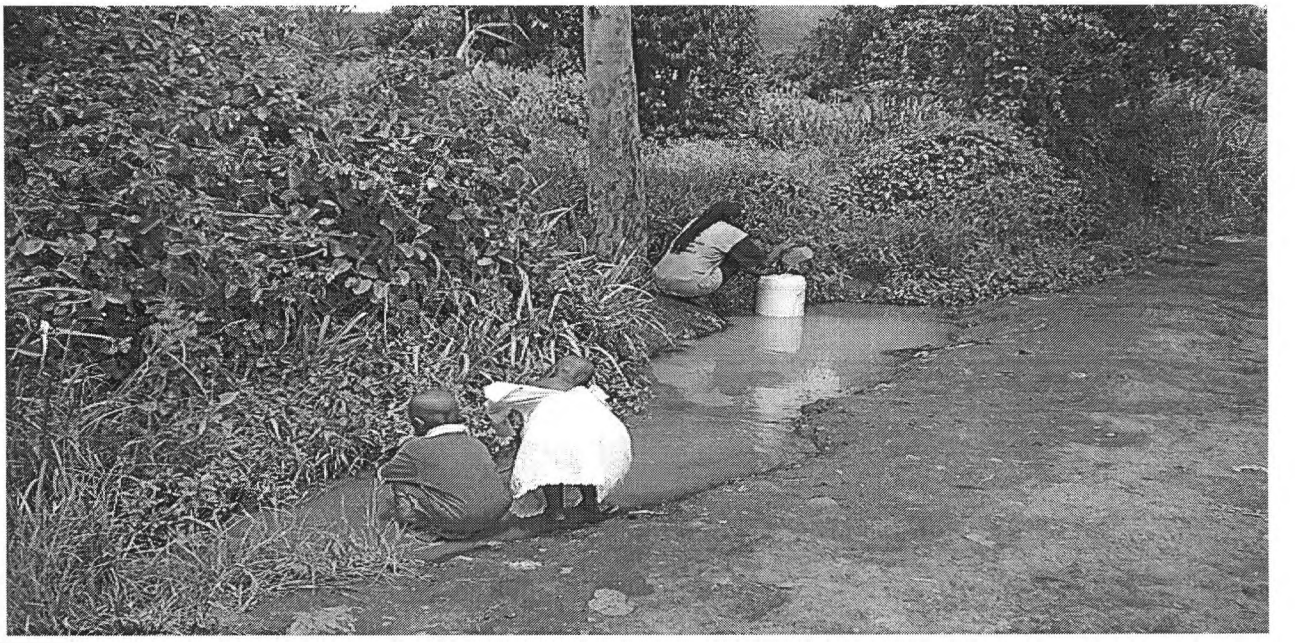
Table 4.12: Effect of Water Interventions

Variable	Wandiege connected	Wandiege unconnected	Bandani
Main water source	Individual piped connection	Water kiosks	Surface water
Water collection time- (Minutes)	7	31	42
Responsible for fetching water- (Adult Female)	-	17	33
Cost of water per month- (Ksh)	512	503	716
Cost of water perceptions - (High)	34.5%	26.5%	85%
Per capita water use- (liters)	28.7	24.7	20.4
Treat water (Yes)	29.6%	25.9%	44.4%
Cost of treating water- Ksh	148	75	59
Incidences of water borne diseases- (in the year)	4	10	25
Cost of treating a water borne disease in the year- (Ksh.)	630	1101	2892
Willingness to pay for water supply improvements - (yes)	55.2%	67.6%	76.7%
Sensitized on importance of sanitation facilities (YES)	44.4%	35%	20%
ACCESS TO SANITATION			
Sharing sanitation facility - (No. of persons)	48	61	73
Access to improved sanitation facility – (Yes)	42.9%	5.9%	1.8%

4.7.1 Improved Water Sources

As noted from the findings on uses of water, all water sources had multiple uses such as washing, cooking and drinking. This finding shows that improved water sources were a necessity for all households. Both Wandiege Connected and Wandiege Unconnected households accessed piped water from the Wandiege borehole albeit with some inconvenience on the part of Wandiege Unconnected households who had to obtain their water from kiosks. Bandani households relied entirely on surface water (Photos 4.7 & 4.8).

Photo 4.7: Unimproved water sources in Bandani (Soko Kogweno spring).



Source: Fieldwork 2009

Photo 4.8: Unimproved drinking water sources in Bandani: An unprotected spring at Kissat bridge

Source: Fieldwork 2009

In times of water shortage, both Wandiege Connected and Wandiege Unconnected households relied on surface water. CRS (2007) found that households in Kisumu were more likely to experience water shortages as compared to those in Nairobi and Mombasa. The shortages in Kisumu lasted days five days or more. This finding confirms the findings of CRS (2007) who found 40% of households in Kisumu experienced water shortages. Gulyani, Talukdar & Mukami (2005) and CRS (2007) reinforce the finding of this study on alternative water sources during shortage. Gulyani, Tulakdur and Mukami (2005) noted that while during water shortage periods, rich households would migrate to water tanker delivery or bottled water, poor households tended to rely on 'free sources' such as unimproved surface water. Water shortage in Bandani meant that the alternative to their main water source (surface water) was still surface water, but further from their homes. This finding is a clear indication that in the absence of water interventions, households tend rely on unimproved water sources. A study previously conducted in Manyatta found that water sources were unimproved (Otiego 2006). Wandiege Project had therefore contributed to improved water sources in Wandiege. A similar water intervention could avail Bandani households improved water sources.

Water quality analysis results presented showed that the only potable source of water was water from Wandiege Project. Again, this goes to show that the water intervention project had contributed greatly to water of potable quality. This was a particularly significant contribution to the health of the household members and their livelihoods. Poor water quality in Kisumu was alluded to in a number of studies in Kisumu. For example, high prevalence of water borne diseases in Kisumu was attributed to poor water quality Otiego (2006); CRS (2007); Maoulidi (2010); Wagah, Onyango & Kibwage (2010). However, these studies did not show evidence of water quality analysis results to ascertain the water quality in question. This study provided water quality analysis results to verify the quality.

4.7.2: Per Capita Water Consumption

Per capita water consumption among the sampled households was fairly similar to the findings of Wagah, Onyango & Kibwage (2010) who found per capita water use among poor households in Kisumu's unplanned settlements to be 22.45 liters per day. Gulyani, Tulakdur & Mukami (2005) found that in Nairobi, Mombasa and Kakamega, per capita water use was 44 liters per capita

among the connected households and 35 liters per capita among the unconnected households. Thompson et al. 2000 had found per capita water use in Kenya, Uganda and Tanzania to be 45.2 liters among the connected households and 28 liters among the unconnected households. In spite of the water intervention in place, per capita water consumption in Kisumu was still much lower compared to other urban centers in East Africa. According to GoK (2007), the basic access limit stipulated is 20 liters per capita. All the households met this criterion. However, all households did not meet the basic water requirement (bwr) necessary for a basic level of health which is 50-100 liters per capita (GoK 2007). This finding points to the need for water interventions that will increase the per capita water use among the urban poor in Kisumu.

Thompson et al. (2001) and Wagah, Onyango & Kibwage (2010) found that distance covered to fetch water was an important factor affecting per capita water consumption as well as mode of water connection. Although Wandiege Connected households had higher per capita water consumption as compared to Wandiege Unconnected and Bandani households, the study found no association between per capita water consumption and water collection time. The study also carried out correlation analysis between the monthly cost of water and per capita water consumption. This study found no association between the two factors. The finding could be explained by the fact that almost all households relied on 'free' sources such as surface water sometimes. The cost of these 'free' sources was not reflected in their monthly cost of water.

The study also found no correlation between number of incidences of water borne diseases and per capita water consumption. This finding confirmed the findings of Thompson et al. (2001). According to Thompson et al. (2001) improved water quality was important in curtailing incidences of water borne diseases while increased water quantities were important in reducing water washed diseases.

4.7.3: Cost of Water

Cost of water was fairer for Wandiege Connected and Wandiege Unconnected households as compared to Bandani households. Although Wandiege connected households paid slightly higher than their unconnected counterparts, they had the convenience of having water in their homes. Bandani households paid a large sum of money on water. Accordingly, the households'

perceptions on the price paid for water reflected that Bandani households felt they were paying a high price for their water as compared to the Wandiege Connected and Wandiege Unconnected households. This finding showed that in the absence of water interventions, water costs more for households. This finding was akin to the findings of CRS (2007). For Example, CRS (2007) found that poor households in Kisumu were likely to be spending a higher proportion of their income on water as compared to households in Nairobi and Mombasa. Thompson et al. (2001) also found that lower income households in East Africa were more likely to be spending a significant proportion of their income on water and that the money spent on water was more likely to be sacrificed from their food budget. These were the households that did not have access to piped water. According to GoK (2007), the cost of purchasing water should not compromise an individual's capacity to purchase other essential goods and should not exceed 5% of household income. The study established that households that spent more money on water were spending less money on food. This finding shows that water interventions that could avail water at a reasonable cost would offer substantial nutritional benefits for the poor.

Thompson et al. (2001) also noted that estimating the cost of water for unconnected households was complex. Thompson et al. (2001) argued that connected households simply paid a monthly fee to the service provider while for an unconnected household, there was a direct cash price paid at the source as well as time and energy expended travelling to and from the water source and carrying it home. In addition, there was an opportunity cost of what the individuals could have been doing if they were not collecting water. It was observed that converting these costs into a comparative cash value was difficult. These inconveniences could be termed as the 'social cost' of obtaining water which somewhat impact negatively on the 'livelihood circumstances' of the households.

4.7.4 Water Collection Time

Households with individual piped water connection spent the least time in water collection (Wandiege Connected) as compared to Wandiege Unconnected who relied on water kiosks and Bandani households who relied on surface water. This finding showed that the ideal water intervention for time saving benefits was the individual piped water connection. This finding confirmed the findings of Gulyani, Talukdar and Mukami (2005) who found a significant

relationship between water collection time and household's main source of water. For example, piped households spent 5 minutes in water collection as compared to those relying on kiosk (55 minutes). The finding also showed that individual piped water connections helped to meet the stipulated time limit for fetching water for urban settings. According to GoK (2007), the time limit should not exceed 30 minutes. Wandiege Connected households met this criterion unlike Wandiege Unconnected and Bandani households who did not have individual pipe water connections.

The study had expected that households spending more time for water collection tasks to be willing to pay more money for water supply improvements. From the study findings, it was observed that Bandani households spent the longest time is water collection as compared to Wandiege Connected and Wandiege Unconnected households. It was observed that Bandani households expressed the highest percentage of willingness to pay for improvements. The study then carried out correlation analysis between water collection time and willingness to pay for water supply improvements. The study found that there was no association between the two factors. This meant that the observed relationship between water collection time and willingness to pay for water supply improvements was not significant and was therefore a pure chance event. This finding was akin to that of Ahiblame, Engel & Vernot (2012) who observed that socially desirable willingness to pay for improvements would not necessarily translate into actual ability to pay because people who are willing to pay may not have the means to pay.

This study found that the primary water collector was the female household head. This finding coincided with the findings of CRS (2007) where the primary water collector was an adult woman. It was also posited that long time spent in water collection compromised the wage earning potential of the women and therefore their livelihoods (Crow & Odaba 2010). Were, Swallow & Roy (2006) found that households that spent less time on water collection activities reported time savings, improved health, cleaner clothes and increased production of tea seedlings, milk and vegetables and therefore better livelihoods.

4.7.5 Access to Sanitation and Households' Health

The study noted that there was a need for improved sanitation facilities. Improved sanitation facilities separate excreta from human contact and thereby partly safeguarding the health of household members as far as well as water quality is concerned. There were too many people sharing sanitation facilities. According to GoK (2007), sanitation facilities have to be of acceptable quality and not more than four households should share one sanitation facility. The findings of this study fell way out of the stipulated criterion. The study found that the number of people sharing a sanitation facility had an association with the number of incidences of water borne diseases reported. Water borne diseases were more prevalent in Bandani where the highest number of persons shared sanitation facilities. Proportionately, the costs of treatment for the diseases were highest in Bandani. This finding showed that there was an urgent need to address to the problem of access to sanitation both in number and in quality. The shared status of a sanitation facility made it less hygienic, encouraging faeco- oral transmission of water borne diseases.

Although the study established that not all households treated their water in spite of its severe contamination, the study found no correlation between households' main sources of water and incidences of water borne diseases. Other than the fact that some households treated their water, this finding had at least two possible explanations: one, all households had an alternative water source when their main water supply was unreliable or two, a water borne disease may also have been contracted by ingesting contaminated food, or neglecting hygiene practices such as hand washing.

Bandani households were less sensitized on importance of the use of sanitation facilities and hygiene practices. They had the highest incidences of water borne disease as compared to their Connected and Unconnected Wandiege counterparts. However, the study found no correlation between the rate of sensitization and the number of incidences of water borne diseases. A possible explanation was that it would not necessarily follow that those sensitized would put into effect the knowledge acquired.

4.8 Hypothesis Testing

The study had two null hypotheses

1) Cost of accessing water had no effect on cost of food

Spearman's rank was used as a measure of association between cost of water and cost of food. The result was that $r_s = 0.25$ indicating a weak but significant association. This association tested at $\alpha = 0.05$ yielded a computed $t = 2.836$ which was greater than the critical $t = 1.66$. The observed association was significant and therefore not a chance event. The result meant that cost of water was one of the factors that influenced the cost of food. This finding therefore showed that interventions that reduced the cost of water yielded significant nutritional benefits for the urban poor.

2) Access to sanitation had no effect on household's health

Spearman's Rank was also used to measure the association between the number of water borne diseases reported and the number of persons sharing one sanitation facility. The result was $r_s = 0.305$ indicating a weak but significant association. The association was tested at $\alpha = 0.05$ yielded a computed $t = 2.373$ which was greater than the critical $t = 1.66$. The observed association was significant and therefore not a chance event. The result meant that more sanitation facilities were necessary to curtail the spread of water borne diseases.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0. Introduction

This chapter wraps up the study by summarizing its main findings. It also gives conclusions and recommendations made from the study

5.1 Summary

The key findings of this study were as follows:

5.1.1 Structure, Management and Operation of Wandiege

Wandiege was a community water supply project, registered with Lake Victoria South Water Services Board. It was independent in its operations. It operated on a nonprofit basis. It was managed by board members who were part of the Wandiege community served by the project, and who were aware of the projects' operations since its inception. The project was at the time of this study currently about 10,000 people.

5.1.2 Access to Water and Sanitation between Intervention and non Intervention Households

Wandiege Connected households had better access to water and sanitation as compared to Wandiege Unconnected and Bandani households. In terms of access to water, Wandiege Connected households: had access to improved water sources; spent less time on water collection; spent less money for water in a month, accessed more per capita quantities of water and had less incidences of water borne diseases in a year. In terms of sanitation, Wandiege Connected households had access to more improved sanitation facilities and there were less people one sharing sanitation facility.

5.1.3 Effect of the Wandiege Project on the Households it Served.

The Wandiege had the effect of availing water at a reasonable cost among the Wandiege Connected and the Wandiege Unconnected households. This meant that a water intervention project similar to Wandiege was likely to reduce the cost of water for Bandani households thus significantly contributing to their food budgets. Wandiege (through SANA) also had the effect of

increasing the number of sanitation facilities thereby reducing the number of persons sharing one sanitation facility. This translated into less incidences of water borne diseases among the Wandiege Connected and Wandiege Unconnected households.

5.2 Conclusion

- Wandiege Connected households were better served in terms of access to water and sanitation as compared to Wandiege Unconnected and Bandani household.
- An intervention that would provide individual piped water connections to households was better than one that availed water through kiosks.
- Access to more sanitation facilities translated into less people sharing one sanitation facility. This was significant in curtailing the spread of water borne diseases. Bandani households would benefit from access to more sanitation facilities.
- A reduction in households' cost of water and a reduction in household' incidences of water borne diseases would make a positive contribution to households' livelihoods.

5.3 Recommendations

From the results and conclusions, the study made both policy and research recommendations as stated below:

5.3.1 Policy Recommendations

- Policy makers should promote water interventions to provide households with individual piped water
- Policy makers should increase the number of sanitation facilities in informal settlements.

5.3.2 Research Recommendations

- Further research should be conducted to establish the correlation between: water collection time and per capita water consumption; per capita water consumption and cost of water; willingness to pay for water supply improvements and water collection time; number of water borne diseases and sources of water; number of water borne diseases

and per capita water consumption, and number of water borne diseases and rate of sensitization on use of sanitation facilities.

- Further research should be conducted on the role of water for household livelihoods by concretizing the effect of availability of water on each of the households' capital assets: physical, human, financial, social, natural and political assets.

REFERENCES

Ahiablame, L, Engel, B & Venort, T 2012, 'Improving water supply systems for domestic uses in urban Togo: The Case of a suburb in Lomé,' *Water*, no. *4*, pp. 123-134.

Akech, M 2009, *Privatization and democracy in East Africa. The promise of administrative law*, East African press publishers, Nairobi.

Bakker, K 2003, 'Archipelagos and networks: urbanization and water privatization in the South' *The Geographical Journal*, vol.169, no. 4, pp.328 – 341.

Bayliss, K 2001, 'Utility privatization in sub –Saharan Africa: a case study of water', *Journal of Modern African Studies*, vol. 41, no. 4, pp. 507 – 531.

Bayliss, K 2003, 'Utility privatisation in sub-Saharan Africa: a case study of water,' *Journal of Modern African Studies*, vol. 41, no. 4, pp. 507–531.

Budds, J & McGranahan, G 2003, 'Are privatization debates missing the point? Experiences from Africa, Asia and Latin America', *Environment and Urbanization*, vol.15, no. 2, pp.87-112.

Citizens Report Card 2007, Citizens Report Card on urban water, sanitation and solid waste services in Kenya: Summary of results from Nairobi, Kisumu and Mombasa, CRS 2007, Nairobi.

Crow, B & Odaba, E 2010, 'Access to water in a Nairobi slum: women's work and institutional Learning' *Water International* Vol. 35, No. 6, pp. 733–747

Davis, J 2005, 'Private sector participation in the water and sanitation sector' *Annual Reviews Environment Resources*, vol. 30, pp. 145 – 183.

Deutsche Gesellschaft fuer Technische Zusammenarbeit GmbH 2008, *Water Supply and Sanitation Sector Reforms in Kenya, Tanzania, Uganda and Zambia: Challenges and Lessons,* GTZ, Dar es Salaam.

Gao, Y 2002, Community-based water supply: tubewell program in Lumbini zone, Nepal, M.A Thesis, Tufts University.

Government of Kenya (GoK) 1999 (a), Central Bureau of Statistics (web), 1999 Population and Housing Census, Volume I.

Government of Kenya (GoK) 1999 (b) Sessional Paper no.1 on national policy on water resources management and development. Nairobi. Government Printer.

Government of Kenya (GoK) 2002, *Water Act 2002*. Nairobi.Government Printer.

Government of Kenya (GoK) 2006, *Kenya National Water Development Report: A Report prepared for the UN World Water Development Report II.* Nairobi: Ministry of Water and Irrigation.

Government of Kenya (GoK) 2007 (a), *Water sector reforms and the human right to water.* Nairobi. Ministry of Water and Irrigation.

Governement of Kenya (GoK) 2007 (b), *National water service strategy (2007-2015).*Nairobi: Ministry of Water and Irrigation.

Government of Kenya (GoK) 2008, *Kisumu District Development Plan (2002-2008). Effective management for sustainable economic growth and poverty reduction.* Government Printer. Nairobi.

Government of Kenya (GoK) 2012, *Draft of the National Water Policy 2012.* Nairobi. Ministry of Water and Irrigation.

Gulyani, S, Talukdar D, & Kariuki, R 2005, *Water for the urban poor: Water markets, household demand and service preferences in Kenya.* Washington. DC: The World Bank, Water and Sanitation Sector Board, Discussion Paper No.5.

Hardoy, A & Schusterman, R 2010, 'New models for the privatization of water and sanitation for the urban poor,' *Environment&Urbanization*, vol.12, no. 2, October, pp.63-76.

Institite of Economic Affairs 2007, *A rapid assessment of Kenya's water, sanitation and sewerage framework,* IEA, Nairobi.

Ishaku, H, Peters, A, Haruna, A & Dama, F 2010, 'The Role of private water vending in Nigeian peri-urban informal settlements: Implication for policy makers,' *Journal of Water Resource and Protection*, no.2, pp. 1082-1087.

K'Akumu, A 2006, 'Privatization model for water enterprise in Kenya', *Journal of Water Policy,* no.8, pp. 539-557.

Karn, S & Harada, H 2002, 'Field survey on water supply, sanitation and associated health impacts in urban poor communities: a case from Mumbai City, India' *Water Science and Technology*, vol. 46, no. 11–12, pp. 269–275.

Kariuki, M & Schwartz, J 2005, *Small-Scale Private Service Providers of Water Supply and Electricity: A Review of Incidence, Structure, Pricing and Operating Characteristics.* World Bank Policy Research Working Paper no. 3727.

Kimani, E, Zulu E, & Undie C 2007, *Health and livelihood implications of the marginalization of slum dwellers in the provision of water and sanitation services in Nairobi city.* Paper

presented at the "PRIPODE workshop on Urban Population, Development and Environment Dynamics in Developing Countries", Nairobi, 11th-13th June, 2007.

Kisumu City Council (KCC) 2005, *Kisumu city environmental profile on sustainable urban mobility*. Kisumu City Council. Kisumu.

Kjellen, M & McGranahan, G 2006, '*Informal water vendors and the urban poor*. London: International Institute for Environment and Development (IEED), Human Settlements Discussion Paper Series, Theme: Water-3.

Lake Victoria South Water Services Board 2008, *Kisumu Water Supply and Sanitation Project. Long Term Action Plan: Water Design Report*. Prepared by Mouchel Parkman, J. Pachett (MP), Otieno Odongo and Partners.

Maoulidi, M, 2010. *Water and sanitation needs assessment for Kisumu city, Kenya*. Millennium City Initiatives (MCI) social sector working paper series no.12. New York. United States.

Marvin, S & Laurie, N 1999, 'An emerging logic of urban water management, Cochabamba, Bolivia' *Urban Studies*, vol. 36, no. 2, pp. 341–357.

Murage, E & Ngindu, A 2007, 'The quality of water slum dwellers use: The case of a Kenyan slum', *Journal of Urban Health*, vol. 84, pp 829-838.

New Zealand's International Aid and Development Agency 2006, *Sustainable Livelihoods Approach Guideline*, NZAID, New Zealand.

Nyanchanga, E & Nilsson, D 2008, 'Pipes and politics: A century of change and continuity in Kenyan urban water supply', *Journal of Modern African Studies*, vol.46, no.1, pp. 133 – 158.

Nicol, A 2000. *Adopting sustainable livelihoods approach to water projects: Implications for policy practice*. Overseas Development Institute (ODI) working paper no. 133. London

Nyangena, K 2008, 'Privatization of water and sanitation services in Kenya: challenges and prospects', *Journal of Africa Development*, Vol. 4, no. 8, pp. 117-131.

Ong'or, B, & Long Cang, S 2007, 'Water supply crisis and mitigation options in Kisumu city, Kenya' *International Journal of Water Resources Development*, vol. 23, no.3, pp. 485-500.

Otiego, L 2006, Commercialization of water services in informal settlements: Case study of Manyatta municipality in Kisumu, M.A Thesis, University of Nairobi

Owuor, S & Foeken, D 2009, *Water reforms and interventions in urban Kenya: Institutional set up, emerging impacts and challenges*. African Studies Center working paper no. 83/100. Leiden.

Prasad, N 2006, 'Privatization results: private sector participation in water services after 15 years', *Development Policy Review*, vol. 24, no.6, pp. 669 – 692.

Public Services International Research Unit 2001, *Water privatization in Africa: lessons from three case studies*, PSIRU.London.

Ratchford, B, Lee, M & Talukdar, B 2003. "The Impact of the Internet on Information Search for Automobiles." *Journal of Marketing Research,* vol. 40, no. 2, pp. 193–209.

RTI 2005, *Mobilization of private sector resources for urban water services in sub Saharan Africa: Case studies of water provision in the city of Dakar, Senegal and the cities of Nyeri and Eldoret , Kenya.* New York.

Thompson, J, Porras, I, Tumwine, J, Mujwahuzi, M, Katua, M, Johnstone, N, & Wood, L 2001, 'Drawers of water (II): 30 Years of change in domestic water use and environmental health in East Africa' *Environment and Urbanization,* vol.12, no.2, October, pp.37-53.

United Nations Settlement Programme 2005, *Cities without slums: Situation analysis of informal settlements in Kisumu,* UN HABITAT. Nairobi.

United Nations Development Programme 2006, *Human Development Report 2006- Beyond scarcity: Power, poverty and the global water crisis*, UNDP, New York.

United Nations Economic and Social Council 2005, *Public –Private partnerships for service delivery: water and sanitation*, UNECA. Addis Ababa.

United Nations Committee on Economic, Social and Cultural Rights 2002, General Comment 15. Geneva. UN ECOSOC

Wagah, G, Onyango, G, & Kibwage, J 2010, 'Accessibility of water services in Kisumu municipality, Kenya', *Journal of Geography and Regional Planning*, vol. 3, no.4, pp 114 – 125.

Wambua, S 2004, 'Water privatization in Kenya', Global issue papers, No.8. Nairobi, Kenya.

Were, E, Swallow, B, & Roy, J 2006. *Water, women and local social organization in Western Kenya highlands*. Paper presented at the "International Research Workshop on Gender and Collective Action", 17th -21st October, 2005 Chiang Mai, Thailand.

WHO & UNICEF (2006), *Core questions on drinking water and sanitation for household surveys*.World Health Organization, Geneva, Switzerland.

http://www.auroville.info/ACUR/documents/laboratory/report_microbiological_tests

APPENDICES

Appendix 1: Questionnaire

Department of Geography & Environmental Studies

University of Nairobi

In collaboration with

African Studies Centre	*Sana International*	*Radboud University*
Leiden, The Netherlands	*Kisumu, Kenya*	*Nijmegen, The Netherlands*

The Impact of Water Sector Reforms and Interventions on the Livelihoods of the Urban Poor Households: A Study of Kisumu Municipality, Kenya

*The information you obtain through this questionnaire is strictly **confidential** and will be used only for academic purposes.*

(Interview the head of household or spouse but preferably the female spouse)

Date of interview	
Name and code of interviewer	
Name of the respondent	
Area of interview	

FORM 1: HOUSEHOLD DEMOGRAPHIC CHARACTERISTICS (2009)

Q1.1. Household characteristics:

Name	Relation to Hh head	Gender	Age	Marital status	Education level	Occupational status	Type of occupation

Relation to household head
[1] Household head
[2] Spouse
[3] Son/daughter
[4] Brother/sister
[5] Father/mother
[6] Other relative
[7] Non relative
[8] Worker
[9] Other (specify _____)

Sex
[1] Male
[2] Female

Marital status
[1] Never married
[2] Married
[3] Divorced
[4] Widowed
[5] Separated
[6] Staying together
[7] Not stated/don't know

Education level
[1] None
[2] Primary
[3] Secondary
[4] Above secondary
[5] Not stated/don't know

Occupational status
[1] Regular (formal) employment
[2] Temporary (formal) employment
[3] Self-employed/formal sector
[4] Self employed/informal sector
[5] Casual labour
[6] Unemployed (looking for a job)
[7] None (student/child)
[8] Home maker
[9] Other (specify

Age (in completed years) _____)

FORM 2: BACKGROUND INFORMATION

Q2.1. In which year did you come to Kisumu town/city? _____

Q2.2. In which year did you come to this estate? _____

Q2.3. Have you ever stayed in other estates of this town/city? *[1]* Yes *[2]* No
Q2.3a. **If yes**, which one(s)? _____

Q2.4. In which year did you start living in this house? _____

Q2.5. What is your tenure status? *[1]* Own house *[2]* Rented *[9]* Other (specify: _____)
Q2.5a. **If rented**, how much do you pay per month? _____

Q2.6a. **Observe** roofing material of house: *[1]* Iron sheet *[2]* Tin *[3]* Grass *[9]* Other (specify: _____)
Q2.6b. **Observe** wall material of house *[1]* Permanent *[2]* Semi permanent *[3]* Mud *[4]* Iron sheet *[5]* Tin
[6] Wood *[9]* Other (specify: _____)

Q2.7. Which of the following items does the household possess? *[1]* Electricity *[2]* Cell phone (no.: __)
[3] Radio (no.: __) *[4]* TV *[5]* Gas cooker/meko *[5]* Refrigerator *[6]* Bicycle (no.: __) *[7]* Motor bike

FORM 3: ACCESS TO WATER (2009)

Q3.1. Access to water situation: rapid assessment
(Note that multiple answers may apply in some cases)

	Sources of water	Main source	Uses of water	Location of water source	Buy the water?	Cost per unit	Treat the water?	Mode of treatment
Piped water (individual)								
Piped water (landlord's)								
Piped water (neighbour's)								
Piped water (public standpipe)								

Piped water (water kiosk) *[1] Council [2] NGO [3] CDF [9] Other (specify)*								
Borehole (individual)								
Borehole (landlord's)								
Borehole (neighbour's)								
Shallow well (individual) *[1] Protected [2] Unprotected*								
Shallow well (landlord's) *[1] Protected [2] Unprotected*								
Shallow well (neighbour's) *[1] Protected [2] Unprotected*								
Private water vendors *(Specify mode of vending)*								
Roof catchment/rain water								
Surface water *[1] River [2] Lake [3] Spring [4] Pond [9] Other (specify _____)*								

Uses of water	**Location of water source**	**Do you buy/treat the water?**	**Cost per unit**	**Mode of water treatment**
[1] Drinking [2] Cooking [3] Washing/cleaning [9] Other (specify_____)	[1] On plot [2] Off plot	[1] Yes [2] No	(specify unit!)	[1] Boiling [2] Use of chemicals [3] Filtering [4] Solar disinfection [9] Other (specify _____)

3.2. **If location of water source is off plot:**

(3.2a) Who is **normally** responsible for fetching water in the household?

[1] HH-head/spouse (female) *[2]* HH-head/spouse (male) *[3]* Child(ren) (male)
[4] Child(ren) (female) *[5]* Worker *[9]* Other (specify: _____)

(3.2b) Approximately how much time does/do s/he/they spend on fetching water in a day?

Approx. ____ minutes/hours per day

(3.2c) How does this affect the school going children or those working?

Q3.3. **If paying for water:**

(3.3a) Approximately how much (on average) does it cost the household?

[1] Per day _____ **or** *[2]* Per month (bill) _____ **or** *[3]* Included in the rent

(3.3b) How would you describe the amount of money you have to pay for water?

[1] High *[2]* Fair *[3]* Low

(3.3c) Does this households use purchased bottled water? *[1]* Yes *[2]* No

(3.3c.1) **If yes**, approximately how much (on average) does it cost the household?

[1] Per day _____ **or** *[2]* Per month _____

(Probe if this amount is included in Q3.3a and rectify accordingly)

Q3.4. **If treating water:**

(3.4a) Is there any cost associated to this treatment? *[1]* Yes *[2]* No

(3.4b) **If yes**, in what way(s) and approximately how much per given period or per given unit?

Q3.5. **Current water situation of main source of water:**

(3.5a) How regularly do you get water from your main source?

[1] Always (regularly) *[2]* Most of the time *[3]* Now and then (irregularly)

(3.5b) How would you describe the quality of water from your main source?

[1] Good *[2]* Fair *[3]* Low *[4]* Don't know

(3.5c) What are the **other** major problems with your main source of water (i.e. besides regularity and quality)?

Q3.6. What is your daily consumption of water? _____ [9 = don't know; 99 = metered connection]

(In litres; or check and indicate the capacity of the containers mentioned, i.e. jerry cans, buckets, etc)

Q3.7. Is the daily consumption enough for your daily needs *[1]* Yes *[2]* No *[3]* Don't know

FORM 4: COPING WITH WATER SCARCITY

Q4.1. Have you ever experienced some periods of **longer** water scarcity in this area? *[1]* Yes *[2]* No

Q4.2. **If yes**,

Q4.2a. Which year(s) and for how long?

(Probe for the year(s); length of period(s) and if there was water rationing)

Q4.2b. What were your alternative sources of water? _____

Q4.2c. What problems do you encounter as a result of water scarcity?

(Probe for time spent on water collection (including queuing); impact on costs for water; impact on domestic water use; impact on urban farming (where applicable); and impact on other income-generating activities)

Q4.2d. How do you cope with these problems? **(Refer to the problem(s) in Q4.2c and answer accordingly)**

FORM 5: ACCESS TO WATER AND HOUSEHOLD'S HEALTH SITUATION

Q5.1. What are some of the water and sanitation related diseases common in this area?

Q5.2. Has any member of this household suffered from any of these diseases **this year**?

[1] Yes *[2]* No *[3]* Don't know?

Q5.2a. **If yes:**

Household member	Disease	No. of times suffered this year	Visited hospital [1] Yes [2] No	Which hospital [1] Public [2] Private (indicate name)	If paid [1] Yes [2] No	How much (in total)

Q5.3. How does this affect the household (incl. income-generating activities, school going children, etc.)?

FORM 6: ACCESS TO WATER AND LIVELIHOODS

Q6.1. What are the household's sources of livelihood (i.e. income and food-generating activities)?

(Probe on the basis of 'Type of occupation' in Q1.1, including urban farming, rural farming and membership of group(s))

Q6.2. Do any of these livelihood sources directly and/or indirectly require access to and/or use of water?

[1] Yes *[2]* No

Q6.2a. **If yes**, which activities?

Q6.3. How does **unavailability** of water affect these activities?

Q6.4. How does the **unavailability** of water affect the **other** household's income-generating activities?

Q6.5. Do you spend more on **buying water** when it is unavailable? *[1]* Yes *[2]* No

Q6.6. Do you spend more time **looking for water** when it is unavailable? *[1]* Yes *[2]* No

Q6.7. What is the household's present income situation per month (in Kshs)?

[1] Up to 5,000/= *[2]* 5,001-10,000/= *[3]* 10,001-20,000/= *[4]* more than 20,000/=

Q6.8. Roughly how much did this household spend on **food last month**? _____

Q6.9. Roughly how much did this household spend on **water last month**? _____

Q6.10. **If a tenant**, how much did this household spend on **rent last month**? _____

Comments

FORM 7: PERCEPTIONS ON ACCESS TO WATER

Q7.1. What is your perception about the following sources of water in this estate in terms of safety for drinking?

(a) Piped water *[1]* Safe *[2]* Fairly safe *[3]* Not safe

(b) Borehole water *[1]* Safe *[2]* Fairly safe *[3]* Not safe
(c) Shallow well *[1]* Safe *[2]* Fairly safe *[3]* Not safe
(d) Water from private vendors *[1]* Safe *[2]* Fairly safe *[3]* Not safe
(e) Rain water *[1]* Safe *[2]* Fairly safe *[3]* Not safe
(f) Surface water *[1]* Safe *[2]* Fairly safe *[3]* Not safe

Q7.2. What do you think are the **risks** of drinking unsafe water?

Q7.3. Are you willing to pay more for a safe water supply? *[1]* Yes *[2]* No *[3]* Don't know

Q7.4. What do you think should be done to improve your access to safe water supply?

FORM 8: ACCESS TO SANITATION

Q8.1. Does this household have access to a sanitation facility (i.e. toilet)? *[1]* Yes *[2]* No

If yes,

Q8.1a. What type of sanitation facility does the household have access to?

[1] Traditional pit latrine *[2]* Improved pit latrine *[3]* Modern ablution
[9] Other (specify: _____)

Q8.1b. Where is the sanitation facility located?

[1] On plot *[2]* Off plot, not far from here (how far? _____)
[3] Off plot, far from here (how far? _____)

Q8.2. **If pit latrine and source of water is on plot, observe** distance between them: About ____ metres

Q8.3. Do you pay to use the sanitation facility? *[1]* Yes *[2]* No

Q8.3a. **If yes**, how much per single visit? _____

Q8.4. Is the sanitation facility shared (i.e. with other people) *[1]* Yes *[2]* No

Q8.4a. **If yes**, approximately how many people ___ **or** households ___ share it? [9=don't know]

Q8.5. Have you ever been sensitized about hygienic practices in the use of sanitation facilities?

[1] Yes *[2]* No *[3]* Don't know

Q8.5a. **If yes**, by whom and what was the sensitization about?

Q8.6. Who put up the sanitation facility?

[1] Self *[2]* Landlord *[3]* The council *[3]* An NGO (which one?: _____) *[4]* Don't know *[9]* Other (specify: _____)

Q8.7. **If council or NGO-based facility:**

(Q8.7a) Who runs and maintains it?

[1] Self *[2]* The tenants *[3]* Landlord *[4]* The council *[5]* The NGO *[6]* The community *[7]* Don't know *[9]* Other (specify _____)

(Q8.7b) How has this facility benefited you in terms of sanitation situation at the household level and this area in general?

Q8.8. Are there any problems with the sanitation facility you use? *[1]* Yes *[2]* No

Q8.8a. **If yes**, how would you describe these problems and how can they be solved

Comments

FORM 9: THE PROJECT HOUSEHOLDS

Q9.0. Project: *[1]* **Wandiege Community Water Supply Project (Manyatta B)**
[2] **KIWASCO Delegated Management Model (Nyalenda)**

Q9.1. How did you know about this project and what do you know about it?

Q9.2. What are some of the **benefits** you are getting from this project?

Q9.3. What was the access to water situation in this area before the project?

(Guide the respondent that for Q9.4 to Q9.7, we would like him/her to compare the present water supply situation in this area with the situation before the project)

Q9.4. Has the project reduced the occurrence of water-borne diseases in this area?

[1] Yes *[2]* No *[3]* Don't know

Q9.4a. **If yes**, could you indicate which diseases and to what extent do you think they have reduced?

Q9.5. Do you spend less on buying water now than you used to do before the project?

[1] Yes *[2]* No *[3]* Don't know

Q9.5a. **If yes**, could you estimate how much less you spend now?

_____ /day **or** _____ /month **or**_____/container

Q9.6. Do you spend less time on fetching water now than you used to do before the project?

[1] Yes *[2]* No *[3]* Don't know

Q9.6a. **If yes**, could you estimate how much less time now? ___ minutes/day **or** ____hours/day

Q9.7. Is your water supply more regular now than before the project? *[1]* Yes *[2]* No *[3]* Don't know

Q9.7a. **If yes**, could you give an idea of the difference?

Q9.7b. **If no**, why not?

Q9.8. Have you ever benefited from this project in terms of food and income-generating activities (directly or indirectly)? *[1]* Yes *[2]* No *[3]* Don't know

Q9.8a. **If yes**, in what way(s)?

(Probe on the basis of 'Type of occupation' in Q1.1, including livelihood sources and urban farming)

Q9.9. What are some of the **challenges/problems** you are facing in this water project?

Q9.10. **If having an individual connection and meter:**

(9.10a) How often does the meter reader come by? _____ [9 = don't know]

(9.10b) Do you receive your bills regularly? *[1]* Yes *[2]* No *[3]* Don't know

(9.10b.1) **If yes**, how often? _____ [9 = don't know]

(9.10c) Do you have a problem paying your water bill? *[1]* Yes *[2]* No *[3]* Don't know

(9.10c.1) **If yes**, in what way(s)? [9 = don't know]

Q9.11. Did you or one of your household members in any way participate in, or contributed to, this project? *[1]* Yes *[2]* No *[3]* Don't know

Q9.11a. **If yes**, when and in what way(s)?

(Let the respondent speak generally)

Q9.12. Were you or one of your household members involved in this project **before it started**?

[1] Yes *[2]* No *[3]* Don't know

Q9.12a. **If yes**, by whom, in what way(s), and what was the involvement about?

Q9.13. Were you or one of your household members involved in this project **during its implementation**?

[1] Yes *[2]* No *[3]* Don't know

Q9.13a. **If yes**, by whom, in what way(s), and what was the involvement about?

Q9.14. Are you or one of your household members being involved **nowadays**?

[1] Yes *[2]* No *[3]* Don't know

Q9.14a. **If yes**, by whom, in what way(s), and what is the involvement about?

Q9.15. Are you satisfied with the price of water the project is charging? *[1]* Yes *[2]* No *[3]* Don't know

Q9.16. Do you think that the water should be given to the community without paying?

[1] Yes *[2]* No *[3]* Don't know

Q9.17. In general, are you satisfied with the project?

[1] Yes, very much *[2]* Yes *[3]* Indifferent *[4]* Not really *[5]* Not at all

Q9.17a. **If not** ('not really' or 'not at all' in Q9.17), why not?

Q9.18 What are in your opinion the **problems/challenges** of this water supply project?

Q9.19. Would you recommend the same kind of a community water supply project to other areas or communities? *[1]* Yes *[2]* No *[3]* Don't know

Q9.18a. **If yes**, why; **if no**, why not?

General comments:

Appendix 2: Detailed water quality analysis results

MINISTRY OF WATER AND IRRIGATION
LAKE VICTORIA ENVIRONMENTAL MANAGEMENT PROGRAMME
WATER QUALITY COMPONENT
P.o Box 1922 Kisumul,Tel /Fax:Kisumu 2024779,E-mail:lvempwater@swiftkisumu.com

BACTERIOLOGICAL EXAMINATION OF WATER

Sample No. 297/2009

Time and date sample taken...11:15 am.....30/11//09.

Time and date sample examined...1/12/09.....8:30 a.m

Taken by...Mr....Okungu

Authority

Reason for sampling...WATER QUALITY CHECK
(if water is suspected of causing ill health please say so)

Is it protected?..... PROTECTED BORE HOLE

If so, how?..... .SEALED AT THE WELL MOUTH
(is it completely covered, or sides only?)

Is there a pump?. .....YES

Has it been overhauled recently?

Exact site sample taken from.....WANDIEGE PRIMARY BORE HOLE
(I.e. tap in kitchen, through cistern or direct from mains)

Are there any latrines or other sources of pollution?

If so, where?..

Is it a chlorinated supply?.....NO

Report

Total Coli form Count (MF, 37°C)..... 1 cfu /100ml

Fecal Coli form Count (MF, 44°C)..... NIL /100mL

.....WATER IS POTABLE.....

ANALYST: R.K
FOR: PROJECT MANAGER

MINISTRY OF WATER AND IRRIGATION

LAKE VICTORIA ENVIRONMENTAL MANAGEMENT PROGRAMME

WATER QUALITY COMPONENT

P.o Box 1922 Kisumu,Tel /Fax:Kisumu 2024779,E-mail:lvemp water@swiftkisumu.com.

CHEMICAL ANALYSIS REPORT

Lab. Ref: No .297/09 Date of Sampling: 30/12/09

Source: **Wandiege Primary Bore Hole** Date received: 30 /12/09

Purpose: **Domestic** Submitted by: **George Anyona**

Parameter	Unit	Results	Permissible level	Remarks
Temperature	°C	30.6		
pH	pH Scale	7.54	6.5-8.5	
Dissolved Oxygen (DO)	mg0_2/l			
Turbidity	N.T.U./J.T.U.	41.8	<5	
Conductivity	µS	1298	1000	
Magnesium	mgMg^{2+}/l	8.16	100	
Nitrite	mgN/l			
Phosphorus (PO_4)	mg/P/l	0.07		
Calcium	Mg/l Ca^{2+}	10.2	250	
Fluoride	mg/l F	0.5	1.5	
Total Alkalinity	mg/$CaC0_3$/l	40		
Chloride	mgCl/l	31	250	
Ammonia	mgN/l			
Nitrate	mgN/l	0.1	10	
Total Dissolved Solids	mg/l	647	500	
Total Hardness	$MgCaCO_3$/l	62		

COMMENTS: Slightly turbid water, but chemically suitable for domestic use.

Analyst: R.K.Kuto

For: PROJECT MANAGER

PROJECT MANAGER
LVEMP Date: 1/12/09
WATER QUALITY COMPONENT
MINISTRY OF WATER & IRRIGATION
P. BOX 1922 KISUMU (KENYA)

MINISTRY OF WATER AND IRRIGATION
LAKE VICTORIA ENVIRONMENTAL MANAGEMENT PROGRAMME
WATER QUALITY COMPONENT
P.o Box 1922 Kisumu,Tel /Fax:Kisumu 2024779,E-mail:lvempwater@swiftkisumu.com.

BACTERIOLOGICAL EXAMINATION OF WATER

Sample No. 296/2009

Time and date sample taken...10:30 am.....30/11//09.....

Time and date sample examined...1/12/09.....8:30 a.m.....

Taken by...Mr....Okungu.....

Authority.....

Reason for sampling...WATER QUALITY CHECK.....
(if water is suspected of causing ill health please say so)

Is it protected?..... OPEN RIVER FLOW.....

If so, how?.....
(is it completely covered, or sides only?)

Is there a pump?. .....N/A.....

Has it been overhauled recently?.....

Exact site sample taken from.....NYAMASARIA RIVER.....
(I.e. tap in kitchen, through cistern or direct from mains)

Are there any latrines or other sources of pollution?.....

If so, where?.....

Is it a chlorinated supply?.....NO.....

Report.....

Total Coli form Count (MF, 37°C)..... TNTC /100mL.....

.Fecal Coli form Count (MF, 44°C)..... TNTC /100mL.....

* TNTC- Too Numerous To Count.

.....WATER IS SEVERELY CONTAMINATED BY FECAL COLIFORMS.....

ANALYST: R.KUTO
FOR: PROJECT MANAGER

MINISTRY OF WATER AND IRRIGATION
LAKE VICTORIA ENVIRONMENTAL MANAGEMENT PROGRAMME
WATER QUALITY COMPONENT
P.o Box 1922 Kisumul,Tel /Fax:Kisumu 2024779,E-mail:lvempwater@swiftkisumu.com.

CHEMICAL ANALYSIS REPORT

Lab. Ref: No .296/09 Date of Sampling: 30/12/09

Source: Nyamasaria River Date received: 30 /12/09

Purpose: Domestic Submitted by: George Anyona

Parameter	Unit	Results	WHO Permissible level	Remarks
Temperature	°C	24.8		
pH	pH Scale	6.21	6.5-8.5	
Dissolved Oxygen (DO)	mg0_2/l			
Turbidity	N.T.U./J.T.U.	1372	<5	
Conductivity	µS	80.2	1000	
Magnesium	mgMg^{2+}/l	2.4	100	
Nitrite	mgN/l			
Phosphorus (PO_4)	mg/P/l	0.55		
Calcium	Mg/l Ca^{2+}	4.4	250	
Fluoride	mg/l F	0.8	1.5	
Total Alkalinity	mg/$CaC0_3$/l	18		
Chloride	mgCl/l	80	250	
Ammonia	mgN/l			
Nitrate	mgN/l	0.2	10	
Total Dissolved Solids	mg/l	39.2		
Total Hardness	$MgCaCO_3$/l	22		

COMMENTS: The water is very turbid and requires full treatment if to be use for domestic purpose. Other chemical parameters are within acceptable limits.

Analyst: R.K.Kuto
For: PROJECT MANAGER

Date: 1/12/09

MINISTRY OF WATER AND IRRIGATION
LAKE VICTORIA ENVIRONMENTAL MANAGEMENT PROGRAMME
WATER QUALITY COMPONENT
P.o Box 1922 Kisumul,Tel /Fax:Kisumu 2024779,E-mail:lvempwater@swiftkisumu.com.

BACTERIOLOGICAL EXAMINATION OF WATER

Sample No. 299/2009.....

Time and date sample taken...12:30 am.....30/11//09.....

Time and date sample examined...1/12/09.....8:30 a.m.....

Taken by...Mr....Okungu.....

Authority.....

Reason for sampling...WATER QUALITY CHECK.....
(if water is suspected of causing ill health please say so)

Is it protected?.....UNPROTECTED SPRING.....

If so, how?.....
(is it completely covered, or sides only?)

Is there a pump?. .....N/A.....

Has it been overhauled recently?.....

Exact site sample taken from.....FOREST WATER SPRING.....
(I.e. tap in kitchen, through cistern or direct from mains)

Are there any latrines or other sources of pollution?.....

If so, where?.....

Is it a chlorinated supply?.....NO.....

Report.....

Total Coli form Count (MF, 37°C)..... TNTC /100mL.....

Fecal Coli form Count (MF, 44°C)..... TNTC /100mL.....

* TNTC- Too Numerous To Count.

.....WATER IS SEVERELY CONTAMINATED BY FECAL COLIFORMS... (WATER IS NOT POTABLE).....

ANALYST: R.KUTO
FOR: PROJECT MANAGER

PROJECT MANAGER
L.V.E.M.P
WATER QUALITY COMPONENT
MINISTRY OF WATER & IRRIGATION
P.O. BOX 1922 KISUMU (KENYA)

MINISTRY OF WATER AND IRRIGATION
LAKE VICTORIA ENVIRONMENTAL MANAGEMENT PROGRAMME
WATER QUALITY COMPONENT
P.o Box 1922 Kisumul,Tel /Fax:Kisumu 2024779,E-mail:lvempwater@swiftkisumu.com.

CHEMICAL ANALYSIS REPORT

Lab. Ref: No .299/09 — Date of Sampling: 30/12/09

Source: Forest Water — Date received: 30 /12/09

Purpose: Domestic — Submitted by: George Anyona

Parameter	Unit	Results	Permissible level	Remarks
Temperature	°C	27.7		
pH	pH Scale	5.85	6.5-8.5	
Dissolved Oxygen (DO)	mg0_2/l			
Turbidity	N.T.U./J.T.U.	22.3	≤5	
Conductivity	µS	1317	1000	
Magnesium	mgMg^{2+}/l	12.8	100	
Nitrite	mgN/l			
Phosphorus (PO_4)	mg/P/l	0.28		
Calcium	Mg/l Ca^{2+}	14	250	
Fluoride	mg/l F	0.52	1.5	
Total Alkalinity	mg/$CaC0_3$/l	112		
Chloride	mgCl/l	30	250	
Ammonia	mgN/l			
Nitrate	mgN/l	0.1	10	
Total Dissolved Solids	mg/l	668	500	
Total Hardness	Mg$CaCO_3$/l	15.6		

COMMENTS: Slightly turbid and acidic water, but chemically fit for domestic use

Analyst: R.K.Kuto
For: PROJECT MANAGER

PROJECT MANAGER
L.V.E.M.P. Date: 17/2/09
WATER QUALITY COMPONENT
MINISTRY OF WATER & IRRIGATION
P.O. Box 1922 KISUMU (KENYA)

MINISTRY OF WATER AND IRRIGATION
LAKE VICTORIA ENVIRONMENTAL MANAGEMENT PROGRAMME
WATER QUALITY COMPONENT
P.o Box 1922 Kisumul,Tel /Fax:Kisumu 2024779,E-mail:lvempwater@swiftkisumu.com.

BACTERIOLOGICAL EXAMINATION OF WATER

Sample No. 298/2009

Time and date sample taken...11:50 am.....30/11//09.....

Time and date sample examined...1/12/09.....8:30 a.m.....

Taken by...Mr....Okungu.....

Authority.....

Reason for sampling...WATER QUALITY CHECK.....
(if water is suspected of causing ill health please say so)

Is it protected?..... PROTECTED SHALLOW WELL.....

If so, how?.....
(is it completely covered, or sides only?)

Is there a pump?. .....N/A.....

Has it been overhauled recently?.....

Exact site sample taken from.....BANDANI MOSQUE SHALLOW WELL.....
(I.e. tap in kitchen, through cistern or direct from mains)

Are there any latrines or other sources of pollution?.....YES.....

If so, where?.....LATRINES NEAR BY.....

Is it a chlorinated supply?.....NO.....

Report.....

Total Coli form Count (MF, 37°C)..... TNTC /100mL.....

Fecal Coli form Count (MF, 44°C)..... TNTC /100mL.....

* TNTC- Too Numerous To Count.

...WATER IS SEVERELY CONTAMINATED BY FECAL COLIFORMS...(WATER IS NOT POTABLE).....

ANALYST: R.KUTO
FOR: PROJECT MANAGER

WATER QUALITY COMPONENT
MINISTRY OF WATER & IRRIGATION
P.O. BOX 1922 KISUMU (K-ENYA)

MINISTRY OF WATER AND IRRIGATION

LAKE VICTORIA ENVIRONMENTAL MANAGEMENT PROGRAMME

WATER QUALITY COMPONENT

P.o Box 1922 Kisumul,Tel /Fax:Kisumu 2024779,E-mail:lvempwater@swiftkisumu.com.

CHEMICAL ANALYSIS REPORT

Lab. Ref: No .298/09 — Date of Sampling: 30/12/09

Source: Bandani Mosque — Date received: 30 /12/09

Purpose: Domestic — Submitted by: George Anyona

Parameter	Unit	Results	Permissible level	Remarks
Temperature	°C	27.5		
pH	pH Scale	6.48	6.5-8.5	
Dissolved Oxygen (DO)	mgO_2/l			
Turbidity	N.T.U./J.T.U.	3.14	<5	
Conductivity	µS	1881	1000	
Magnesium	$mgMg^{24}/l$	10.4	100	
Nitrite	mgN/l			
Phosphorus (PO_4)	mg/P/l			
Calcium	Mg/l Ca^{24}	23.5	250	
Fluoride	mg/l F	0.52	1.5	
Total Alkalinity	$mg/CaCO_3/l$	190		
Chloride	mgCl/l	30	250	
Ammonia	mgN/l			
Nitrate	mgN/l		10	
Total Dissolved Solids	mg/l	947	500	
Total Hardness	$MgCaCO_3/l$	24.8		

COMMENTS: - Clear water that is chemically suitable for domestic use.

Analyst: R.K.Kuto
For: PROJECT MANAGER

PROJECT MANAGER
LVEMP Date: 7/1/09
WATER QUALITY COMPONENT
MINISTRY OF WATER & IRRIGATION
P.O. BOX 1922 KISUMU (KENYA)

MINISTRY OF WATER AND IRRIGATION
LAKE VICTORIA ENVIRONMENTAL MANAGEMENT PROGRAMME
WATER QUALITY COMPONENT
P.o Box 1922 Kisumul,Tel /Fax:Kisumu 2024779,E-mail:lvempwater@swiftkisumu.com.

BACTERIOLOGICAL EXAMINATION OF WATER

Sample No. 295/2009.....

Time and date sample taken...10:00 am.....30/11//09.....

Time and date sample examined...1/12/09.....8:30 a.m.....

Taken by...Mr....Okungu.....

Authority.....

Reason for sampling...WATER QUALITY CHECK.....
(if water is suspected of causing ill health please say so)

Is it protected?..... PROTECTED SPRING.....

If so, how?.....COMPLETELY COVERED.....
(is it completely covered, or sides only?)

Is there a pump?. .....

Has it been overhauled recently?.....

Exact site sample taken from.....BANDANI PROTECTED SPRING OUTLET.....
(I.e. tap in kitchen, through cistern or direct from mains)

Are there any latrines or other sources of pollution?.....

If so, where?.....

Is it a chlorinated supply?.....NO.....

Report.....

Total Coli form Count (MF, 37°C)..... 98 cfu. /100mL.....

.Fecal Coli form Count (MF, 44°C)..... 49 cfu /100ml.....

.....WATER IS BACTERIOLOGICALLY CONTAMINATED BY FECAL COLIFORMS... (WATER NOT POTABLE).....

PROJECT MANAGER

ANALYST: R.KUTTO V E M P

FOR: PROJECT MANAGER WATER QUALITY COMPONENT
MINISTRY OF WATER & IRRIGATION
P. BOX 1922, KISUMU (KENYA)

MINISTRY OF WATER AND IRRIGATION
LAKE VICTORIA ENVIRONMENTAL MANAGEMENT PROGRAMME
WATER QUALITY COMPONENT
P.o Box 1922 Kisumul,Tel /Fax:Kisumu 2024779,E-mail:lvempwater@swiftkisumu.com.

CHEMICAL ANALYSIS REPORT

Lab. Ref: No .295/09

Date of Sampling: 30/12/09

Source: **Bandani spring**

Date received: 30 /12/09

Purpose: **Domestic**

Submitted by: **George Anyona**

Parameter	Unit	Results	WHO Permissible level	Remarks
Temperature	°C	26.6		
pH	pH Scale	5.52	6.5-8.5	
Dissolved Oxygen (DO)	$mg0_2/l$			
Turbidity	N.T.U./J.T.U.	0.48	<5	
Conductivity	µS	347	1000	
Magnesium	$mgMg^{2+}/l$	Nil	100	
Nitrite	mgN/l			
Phosphorus (PO_4)	mg/P/l	0.15		
Calcium	$Mg/l\ Ca^{2+}$	Nil	250	
Fluoride	$mg/l\ F^-$	0.48	1.5	
Total Alkalinity	$mg/CaC0_3/l$	226		
Chloride	mgCl/l	35	250	
Ammonia	mgN/l			
Nitrate	mgN/l	0.1	10	
Total Dissolved Solids	mg/l	174	500	
Total Hardness	$MgCaCO_3/l$	4		

COMMENTS: -The water is clear but slightly acidic. Other chemical parameters are within acceptable limits.

Analyst: R.K.Kuto
For: PROJECT MANAGER

12/09
L.V.E.M.P
WATER QUALITY COMPONENT
MINISTRY OF WATER & IRRIGATIO
P.O. BOX 1922 KISUMU (KENYA)