

UNIVERSITY OF NAIROBI

RESEARCH PROJECT

**CHALLENGES RELATED TO AVAILABILITY OF DOMESTIC WATER IN KIBERA
SLUM NAIROBI CITY COUNTY**

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DECLARATION

Declaration by the student

This research is my original work and has not been presented for any degree in any other university.

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DEDICATION

To my family and friends for support and encouragement throughout my education.

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ABBREVIATIONS AND ACRONYMS

CI	Confidence Interval
GDP	Gross Domestic Product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Federal
JMP	Joint Monitoring Program
KENSUP	The Kenya Slum Upgrading Program
KNBS	Kenya National Bureau of Statistics
KPLC	Kenya Power and Lighting Company
KWAHO	Kenya Water for Health Organization
m³	Cubic meter
MDGs	Millennium Development Goals
MWI	Ministry of Water and Irrigation
NCWSC	Nairobi City Water and Sewerage Company
NGOs	Non-Government Organizations
NWSS	The National Water Service Strategy
O&M	Operations & Maintenance
OR	Odd Ratio
QLI	Quality of Life index
QoL	Quality of Life
RoK	Republic of Kenya
SD	Standard Deviation
SPSS	Statistical Package for Social Science
UN	United Nations
UN Habitat	United Nations Human Settlements Program
UNDP	United Nations Development Program

UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations children's Fund
UON	University of Nairobi
WASREB	The Water Services Regulatory Board
WHO	World Health Organization
WHOQOL	World Health Organization Quality of Life
WSP	Water and Sanitation Program
WSTF	The Water Services Trust Fund
WWAP	World Water Assessment Program

ABSTRACT

Water is indispensable for life since it is a major basic need and is also important for economic activities. Information on the challenges of water supply and its availability is important as it forms a vital baseline for the detection of the positive impacts, the main challenges related to it and how to cope and deal with them. The UN (2013) defined water accessibility as the availability of at least 20 litres of drinking water per person per day with maximum water hauling round trip of 30 minutes and should not spend more than 5% of their income on water. Kenya government (2007) set policies that increase access to safe water to the Kenyan from 60% to 80% by 2015. And water points should be located within 30 minutes round trip from house with flat rate of Ksh 204 for up to 6 cubic meters of water. Objective of the study is to identify challenges related to availability of water among residents of Kibera slums, in Nairobi City County. Study was a community based analytical cross-sectional study that used simple random sampling method, targeting a minimum sample size of 384 households or adults above 18 years during time of data collection. Data was collected by interviewing respondents using interviewer administered semi structured questionnaires and analyzed using SPSS version 23, Chi-Square statistics and other tests were used to test hypothesis. Significance level was used to test hypothesis at significance level of $p < 0.005$ at 95% CI. Results showed that the respondents age ranged from 20 years to 26 years, the mode was 26 years, median 29.00 years and the mean age was 30.77 ± 3.33 . The slums residents 108(29.7%) accessed water from kiosks and spent an average of 24 litres of water per day per person. However, over half of them still consumed below 20 litres. They took an average 40 minutes to collect water every day. Around one third of the respondents spent over 5% of their income on water and they paid three or more times higher cost compared with the flat rate charged by the NCWSC. Water accessibility in slums met neither international guidelines nor national policies at all. Almost 80% of the respondents in both slums perceived realized access to water was a crucial issue to improve their quality of life. Around 60% of respondents expressed their dissatisfaction with the water supply and their daily water consumption. Conclusion is that kiosks which were prevalent in slums provided better water service to the residents with short physical distance, high hygiene conditions, low water cost, few price fluctuations and there was high satisfaction among the respondents with their water supply. It is recommended that improvement of water supply service in low-income communities should be a priority for most government

CHAPTER ONE: INTRODUCTION

1.1 Overview

This chapter provides background information, problem statement, research questions, study objectives, justification and study limitations based on study topic

1.2 Background Information

Wherever they are, people need water to survive. Not only is the human body 60 percent water, the resource is also essential for producing food, clothing, and computers, moving our waste stream, and keeping us and the environment healthy (Danner, 2011). According to the United Nations (2013), water use has grown at more than twice the rate of population increases in the last century. By 2025, an estimated 1.8 billion people will live in areas plagued by water scarcity, with two-thirds of the world's population living in water-stressed regions as a result of use, growth, and climate change (National Geographic Society, 2013). The test we face presently is the means by which to adequately monitor, oversee, and convey the water we have. The water we drink today has likely been around in some structure since, a huge number of years back (Wachira, 2017). While the measure of freshwater on the planet has remained genuinely steady after some time persistently reused through the climate and once more into our cups—the populace has detonated. This implies each year rivalry for a perfect, bountiful supply of water for drinking, cooking, washing, and continuing life escalates. Water shortage is because of horde ecological, political, monetary, and social powers (National Geographic Society, 2013).

Africa faces endemic poverty; food insecurity and pervasive underdevelopment with almost all countries lacking the human, economic and institutional capacities for effectively develop and manage their water resources sustainably (WHO/UNICEF, 2015). Africa's rising population is driving demand for water and accelerating the degradation of water resources in many countries on the continent. By mid-2011, African population, excluding

northern most states, was around 838million and its average natural rate of increase was 2.6% per year, compared to world percentage of 1.2% (Kaushik, *et al.*, 2015). Africa faces a situation of economic water scarcity and current institutional, financial and human capacities for managing water are lacking. The situation is exacerbated by competition for public funding between sectors, and heavy public debt burdens in most countries. In Africa, financing and the institutional capacity to absorb what is available is limited. The danger of spoilage to already made progress against the MDG on water and sanitation is real. Most countries within Africa are falling short to sustain water Sanitation and Hygiene (WASH) commitments (Mwamburi, 2015).

Water crisis is the current struggle that Kenya faces to supply clean water to its population. The human population depends heavily on water resources, not only as a drinking water but also for crops, agriculture and livestock and fishing. For example, wetland grasses are used to feed and keep livestock (Ondieki & Kebaso, 2017). Human populations throughout the country have been affected by a lack of clean drinking water due in large part to the overuse of land and increases in community settlements. A specific example of this is in the Mau Forest, in the highlands of Kenya that is a major watershed for the country. In the Mau Complex individuals have used land for their personal gain, creating homes and farms at the expense of the natural biodiversity (German cooperation, 2017). The obliteration of trees all through the woods has caused enormous soil disintegration, which contaminates the water. This wonder exists everywhere throughout the nation and with the expansion of creature and human waste into effectively contaminated water. It has made discovering clean water increasingly hard for Kenyan natives. The ebb and flow water conditions have caused various issues including numerous ailments and ancestral clashes over the rest of the water assets (UN - Water, 2012)

Kenya's government does not have the funds to maintain strong piping systems. More than half of Kenya's population does not have regular access to piped water, and for most of those who have water it is often in unsanitary condition due to poorly constructed systems that result from malfunctions and vandalism (Rono, 2013). A number of acts and reforms have been put into motion to aid Kenya's situation, but the country still suffers from a water crisis worse than almost any other in the world. In 1974, the government launched the National Water Master Plan, with the goal of having drinkable and available water within walking distance of every household by the year 2010 (Adeleke, *et al.*, 2014)

KIBERA slum is the largest informal settlement in Africa and a home to c It is divided into thirteen official villages with each village having its own elder. They are Kianda, Soweto East, Raila, Kisumu Ndogo, Lindi, Soweto West, Kambi Muru, Laini Saba, Silanga, Kichinjio, Gatwera, Makina and Mashimoni. Water crisis in Kibera is particularly severe for many reasons. Due to a combination of political exclusion, the operation of water mafias, water rationing, and poor infrastructure, residents of Kibera pay more for water than wealthier Kenyans in tapped neighbourhoods of Nairobi, and more than even what Europeans and New Yorkers pay. Kibera households spend up to 20% of their income on water which can be equal to the cost of rent (Marshall, 2011).

On the days water is available, women and children of Kibera spend just under an hour locating a water vendor, queuing up, and carrying back the water. They will pay Ksh 5-20 per 20 litres (4 gallon) jerrycan of water from any of the 650 water vendors in Kibera, roughly 98% of which are private enterprises and 20 that are run by community-based organizations or NGOs. The Nairobi Water and Sewage Company recommends that the price for a jerry can of water be Ksh 1, so even at Ksh 2, residents of Kibera pay eight times the lowest tariff at domestic connections and four times the average tariff in Kenya (World

Bank 2014). In some villages, up to 85% of households are estimated to rely on these private and community owned water kiosks (Umande Trust 2007).

1.3 Statement of the Problem

Most of the slum residents purchase water in 20 litre plastic jerrycans from vendors who store and sell it from standpipes. A related problem is that the streets in urban slums are narrow, unpaved and uneven. Many streets have open drains, doubling as sewers and spreading garbage. It is difficult to carry heavy loads of water from water source to house (Nthenge, 2016). Odira, (2014), reported that water in informal settlements was selling for Ksh 15 to 30 per a 20 litre jerrycan. By depending on private water vendors for their needs, slum residents were inevitably paying higher prices, in some case, they paid as much as ten times more for water. Moreover, the water quality from private vendors is not assured, compared to the quality of piped water supply (United Nations, 2016). Insufficient access to water increases serious security problems such as water-related crimes, conflicts, stealing, leakage and pollution by illegal connections. The most common crimes are theft, muggings and illegal disconnections of water pipes by thieves who collect and sell the water.

Insufficient, low quality and irregular water supply also affects health condition. Although slum residents have water supply, the water is not always safe to drink and use due to lack of water quality management, poor performance of water supply systems and irregular water supplies. One of the major water quality problems is microbiological contamination through sewage seeping into broken or loose pipes or irregular water supply. Although quality of life is more subjective and intangible, access to and quality of basic services such as water, electricity, transportation and sanitation can improve the quality of life of people. Without satisfaction of basic services for human basic rights, high quality of life cannot be expected.

Lack of access to water is the core problem facing urban slum residents in Kenya especially in Kibera slums in the city of Nairobi and has a bearing on the residents' quality of life.

1.4 Research Questions

1. How is the accessibility and affordability of the water supplied to residents of Kibera slums, in Nairobi City County?
2. What is the resident's perception on quality of the water supplied in Kibera Slum, Nairobi City County?
3. What is the quantity of water supplied to residents of Kibera slums, in Nairobi City County?

1.5 Study Objective

1.5.1 Broad Objective

To identify challenges related to use of water among residents of Kibera slums, in Nairobi City County

1.5.2 Specific objectives

Objectives of the study include the following,

1. To assess the accessibility and affordability of the water supplied to residents of Kibera slums, in Nairobi City County
2. To assess the resident's perception on quality of the water supplied in Kibera Slum, Nairobi City County
3. To identify the quantity of water supplied to residents of Kibera slums, in Nairobi City County

1.6 Research Hypothesis

They include the following null hypothesis

1. Water affordability is not significantly related to availability of water among residents of Kibera slums, in Nairobi City County.
2. Water accessibility is not significantly related to availability of water among residents of Kibera slums, in Nairobi City County.
3. Residents perception of quality water is not significantly related to availability of water among residents of Kibera slums, in Nairobi City County
4. The quantity of water supplied is not significantly related to availability of water among residents of Kibera slums, in Nairobi City County

1.7 Justification and Significance of the Study

It is widely assumed that informal settlements lack effective management structures especially in relation to resource allocation and use. An initial survey of the water access situation in Kibera slums indicated that households relied heavily on water kiosks even though some have been reduced to idle structures due to lack of water. This has resulted in the emergence of small-scale water vendors in the area, who increase charges arbitrary depending on the availability, and convenience of their source of water irrespective of the quality. There are many incidences of illegal water connections in Kibera slums and most of these are connected using artisanal methods which result to huge water losses

Availability and accessibility of water in Kibera Slum is restricted. Up to 85% of the family units draw water from stands at over the top costs of between Ksh 5 to Ksh 20 for each 20 liter jerrycan (Otieno, 2013). The normal separation to the closest booth is 40 meters and utilization ranges from 16 to 20 liters for each individual every day. Visit deficiencies that are experienced add to an expansion in costs, separation strolled and time spent. Thus, there is a need to come up with measures on how to counter this water related challenges within the slum.

This research seeks to understand current accessibility of households to water in the urban informal settlement. It is to provide up-to-date information about the water sector approach in urban informal settlement and show potential for improving water accessibility in such areas.

The study will shade light to what the county government and even locals may assist in solving water scarcity e.g. by impressing on water saving technologies. The study also will build the knowledge base to guide adaptation of rural livelihood system, create awareness on adaptation measures on water scarcity. It also allows the assessment of outcomes that facilitate policy consideration and decision making in the face of future uncertainty. The study contributes to

provision of more data on existing water challenges to water related bodies and institutions, if the information is well utilised will reduce the vulnerability of rural community and increase the opportunities for sustainable development.

There is few published information on challenges related to availability of water, yet there are a lot of impacts associated with supply of water in the Kibera slums and other parts of the country. The research findings would help the government and relevant water provision bodies (e.g. Nairobi water and Sewerage Company) by informing them about the identified

causes of erratic water supply to prevent future occurrence. This may ensure water sustainability for the future thus reducing the challenges brought about by reduced water supply. Findings from this study would be important as they provide an input in the future planning by the government due to increased population and environmental management of the natural resources especially water since it is a basic need due. The study findings would act as an eye opener for both municipal council and other environmental organizations to identify the impacts of water supply. This would further provide measures to come up with successful cost-effective implementations to improve water supply to reduce environmental risks.

1.8 Scope and Limitation of the Study

Data in the study will be collected from Kibera slums of Nairobi County. The focus will be on heads of households or residents over 18 years selected from villages in Kibera slums. Since the slum and household to be sampled will be few, the findings from the study will not be generalized to all of the 160 slums in Nairobi County.

1.9 Operational Definition of Terms

Quality of life Quality of life is a measure of well-being of individuals and societies.

Quality of life cannot be simply equated with the term's health status, life style, life satisfaction, mental state or well being

Slum/informal settlement- the term 'informal' is an attempt to encapsulate the characteristics of such settlements. However, slum or informal settlement is understood more widely as areas of inadequate housing, basic services, security and right of land. It has typically high population density, low or very low incomes, high risk from environmental disasters and high morbidity and mortality rates caused by diseases.

Water accessibility- according to the definition of the WHO, water accessibility is defined as the availability of at least 20 litres of drinking water per person per day within a distance of not more than 1 km of the dwelling and a maximum water fetching round trip of 30 minutes

Water crisis- is the lack of sufficient available water resources to meet the demands of water usage within a region.

Water sustainability-refers to proper management of water resources since the world's water is increasingly becoming degraded in quality, threatening the health of people and ecosystems and increasing the cost of treatment.

Watershed- refers to that area of land, a bounded hydrologic system, within which all living things are inextricably linked by their common water course and where, as humans settled, simple logic demanded that they become part of a community.

1.10 Outline of the Chapters

Chapter one has discussed the importance of this study to the slum dwellers as well as to the donors and project implementers. The chapter has identified the objectives and research questions as well as identified the constraints that will be anticipated throughout the research process as well as defining the various significant terms in the context of this study.

Chapter two is going to review the available literature regarding the research topic so as to give better understanding on the project. The chapter will also provide conceptual framework to show how Independent variables relate to Dependent variable.

Chapter three will present the methods and techniques that the researcher will employ in the study. The profile of study area will be done in this chapter so as to give a concept on how the area looks like and its location in the country.

Chapter four presents analysis, presentation and interpretation of data under the following thematic areas; water affordability, accessibility, quality and quantity.

Chapter five is the summary of the study followed by conclusion based on the results of chapter four. The recommendations and suggestions for further research based on the above conclusion are in the same chapter.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of the literature that is relevant to the understanding of challenges related to the availability of water. Understanding and having knowledge of the water challenges among urban populations will enable putting measures to prevent water wastage thus reducing scarcity. This chapter will discuss the challenges related to the usage of water in relation to objectives of the study.

2.2 Water accessibility

Wherever they are, people need water to survive not only for human body but also the resource is also essential for producing food, clothing, and computers, moving our waste stream, and keeping us and the environment healthy. Unfortunately, humans have proved to be inefficient water users. The average hamburger takes 2,400 litres or 630 gallons, of water to produce, and many water intensive crops such as cotton are grown in arid regions. According to the United Nations, water use has grown at more than twice the rate of population increases in the last century. By 2025, an estimated 1.8 billion people will live in areas plagued by water scarcity, with two-thirds of the world's population living in water-stressed regions as a result of use, growth, and climate change (National Geographic Society, 2013).

Effective management and access to water resources is vital to sustainable development and good governance. Governments across the world have spent considerable effort and resources to move towards that goal (Naiga, Penker, & Hogl, 2015). Governments, the public, donors, and development agencies have often neglected challenges in water governance. Some of these challenges are related to policies, access to water resources, participation and water information. MDG Target 7c called on countries to "Halve, by 2015, the proportion of people without sustainable access to safe drinking-water and basic

sanitation." The indicators used to assess the proportion of people with sustainable access to safe drinking water and to basic sanitation are the official MDG indicators (Odira, 2014):

1. The proportion of population using an improved drinking-water source both in urban and rural areas.
2. The proportion of population using an improved sanitation facility both in urban and rural areas.

An improved drinking-water source is defined as one that, by nature of its construction or through active intervention, is protected from outside contamination, in particular from contamination with fecal matter. To allow for international comparability of estimates, Joint Monitoring Program (JMP) uses the following classification to differentiate between "improved" and "unimproved" drinking-water sources (WHO/UNICEF, 2010).

Table 2. 1: JMP classification between improved and unimproved water sources.

Improved drinking water sources	Unimproved drinking water sources
Piped water into dwelling, plot or yard	Unprotected dug well
Public tap/standpipe	Unprotected spring
Tube well/borehole	Small cart with tank/drum
Protected dug well	Tanker truck
Protected spring	Surface water (river, dam, lake, pond, stream, channel, irrigation channel)
Rainwater	Bottled water

Source; WHO/UNICEF, (2015)

Access to safe water is measured by the number of people who have a reasonable means of getting an adequate amount of water that is safe for drinking, washing, and essential household activities, expressed as a percentage of the total population. It reflects the health of a country's people and the country's capacity to collect, clean, and distribute water to consumers (Wrisdale, Mokoena, Mudau, & Geere, 2017). Worldwide, 884 million people have no access to drinking water from improved sources. Sub-Saharan Africa accounts for

more than third of that number, with around 330 million individuals without access to safe drinking water. Africa's advancement towards the MDG drinking water target is moderate and uneven, and the landmass in general won't arrive at the objective (WHO/UNICEF, 2015). In spite of the fact that the extent of individuals in sub-Saharan Africa utilizing improved wellsprings of drinking water expanded by 14 percent from 1990 to 2008, just 60 percent of its populace had such access before the part of the bargain (WHO/UNICEF 2010). In view of ebb and flow patterns, sub-Saharan Africa won't arrive at the MDG water focus until 2040 (United Nations, 2016). An ongoing overview uncovered a disheartening future in which just two nations (Kenya and South Africa) are evaluated to have more than 75 percent of what is expected to accomplish the sanitation target, and five nations are assessed to have in excess of 75 percent of what is expected to accomplish the objective for drinking water (UNFPA, 2011).

Sub-Saharan Africa has by a wide margin the most minimal inclusion paces of funnelled water among world locales (50 percent) (WHO, 2015). The expansion in quantities of individuals with access to other improved wellsprings of drinking water was 3.5 occasions higher than the ascent in individuals with channelled water on premises. Just five percent of the provincial populace gets funnelled water in their homes contrasted with 35 percent of urban inhabitants (WHO/ UNICEF 2010). Africa faces huge challenges with multiple issues that adversely affect public health. One major challenge is the ability for both rural and urban Africans to access a clean water supply. According to the WHO (2015), only 59% of the world's population had access to adequate sanitation systems which is aiming for 75% by the year 2015, will fall short by nearly half a billion people.

The Challenge in Africa was to attain the MDG water provision target: By 2015, reduce by half the proportion of the population without sustainable access to safe drinking water. The Situation in Africa as a whole, didn't meet MDG drinking water target; of its 53 countries,

only 26 were on track to meet it. The high incidence of water-related and waterborne diseases related to the lack of safe drinking water is a drain on human and financial resources (WHO/UNICEF, 2017).

The Constraints in Africa is expanding peri-urban and slum areas; economic process and better demand; geographical isolation; dearth of public utilities and regulation; and high prices of water provision (Chowns, 2014).

The opportunities in Africa; improve financing; encourage privatization through concessions; subsidize Connections; target informal settlements; institute or Improve regulation; target rural communities; and employ simple solutions. There are about 40 million people living in Kenya, of which about 17 million (43 percent) do not have access to clean water. For decades, water scarcity has been a major issue in Kenya, caused mainly by years of recurrent droughts, poor management of water supply, contamination of the available water, and a sharp increase in water demand resulting from relatively high population growth (Joyfillah, 2016). The lack of rainfall affects also the ability to acquire food and has led to eruptions of violence in Kenya. In many areas, the shortage of water in Kenya has been amplified by the government's lack of investment in water, especially in rural areas (Danner, 2011).

Most of the urban poor Kenyans only have access to polluted water, which has caused cholera epidemics and multiple other diseases that affect health and livelihoods. Despite the critical shortage of clean water in Kenyan urban slums, there also is a large rural to urban discrepancy in access to clean water in Kenya. According to the World Bank (2014), slightly less than half of the rural population has access to safe water, as opposed to 32 the urban population where 85 percent have access to safe water. Due to continued population growth, it has been estimated that by the year 2025, Kenya's per capita water availability will be

235 cubic meters per year, about two-thirds less than the current 650 cubic meters (Marshall, 2011).

According to the JMP estimates, access to improved water sources in urban areas faded from ninety-one in 1990 to eighty-three in 2008. In rural areas, however, access inflated from thirty second to fifty-two throughout identical amount (Yu et al., 2016). in step with a distinct definition referred to as "weighted access" the 2009 Impact Report estimates that in 2006–2007 solely thirty seventh of Kenyans had access to adequate and safe potable near to their homes at a reasonable value. vital regional variations in access were reported: the very best level was registered within the space served by Tetu town Water and Sanitation Company (72%) whereas all-time low was recorded in Muthambi in Meru South District (4%) (Koech & Cheruiyot, 2016). Within the capital of Kenya access for identical amount was reported at thirty fifth, as hostile a less realistic figure of forty sixth reported for 2005–2006. Estimates from the Joint program me for installation and Sanitation (JMP) show that in 2008 fifty-nine of Kenyans (83% in urban areas and fifty-two in rural areas) had access to improved potable sources. nineteen of Kenyans (44% in urban areas and twelve-tone system in rural areas) are reported as having access to piped water through a house or yard affiliation. The poor, in particular women and girls, spend a significant amount of time fetching water in both rural and urban areas (Kennedy, 2016). For example, the Citizen Report Card survey (2007) showed that users of water kiosks in cities fetch water 4–6 times per day. In Kisumu, this meant that a poor household spent 112 minutes per day to fetch water at normal times, and as much as 200 minutes per day during times of scarcity.

Kibera receives an estimated 20,000m³ of water per day, 40% of it is unaccounted for water lost through leakage. In Kibera slum; Kianda, Gatwikera and Makina: Water supply is comparatively regular with assortment times of between ten and half-hour. Kibera's

remaining villages experience frequent water shortages and sometimes it takes concerning forty minutes to access water (German cooperation, 2017).

Mashimoni: AN calculable three hundred households share one water purpose. the globe Bank supported distribution network during this village is additional usually than not dry. constant state of affairs applies in city Ndogo: AN calculable two hundred households share one water purpose. There are solely 5 main water points within the village with a median distance of two hundred meters from one another. In Kambi Muru there are seven main storage tanks accessible once every week. urban center and Laini Saba face acute water shortages throughout the time of year, residents are forced to run to the Kenya Medical and analysis Institute and Kianda to access water (World Bank, 2014).

2.3 Water affordability

The privilege to moderate water is basic for driving a real existence in human respect, yet regularly denied in creating just as created nations (Malek, Nor, and Leong, 2013). The money related expense to clients is a more subtle boundary to the arrangement of safe drinking water. The per capita expenses of giving clean water are most elevated in urban regions and in scantily populated rustic regions; by and large (Nthenge, 2016); be that as it may, growing inclusion costs less in provincial territories than in high-thickness urban zones (Tundisi, 2018).

Toward the beginning of the third thousand years, more than one individual in three on the planet experiences hardship and outrage the issue of water. This individual is substantially more frequently a lady than a man (Yongsi, 2010). This bad form is to a great extent implicit and one of the hardest to redress, accurately in light of the fact that it is over every one of an unfairness to ladies. Its main driver is our carelessness and our acquiescence even with Inequality (Kummu et al., 2016). However, while throughout the following fifty years the greater part of humankind is compromised by "water pressure", the fantasy of unadulterated water for all keeps on joining mankind (Nyanchaga, 2011).

Water is a restricted characteristic asset and central forever and wellbeing. In 2010, the World Health Organization gauge that of the world's 6 billion individuals, in any event 1.3 billion need access to safe drinking-water and 2.9 billion people live without access to sanitation frameworks. An expected 14 to 30 thousand individuals, for the most part youthful and old, bite the dust each day from avoidable water-related infections for instance loose bowels (WHO/UNICEF, 2010).

Various crucial human rights can't be completely acknowledged without water which incorporates the accompanying: (United Nations, 2016)

1. Right to life: Without water, no life can be continued.
2. Right to nourishment: Water is fundamental for cultivating: practically 70% of all assembled freshwater is utilized for farming and it is evaluated that more than 33% of worldwide sustenance generation depends on water system.
3. Right to self-assurance: this privilege additionally incorporates the privilege surprisingly to deal with their very own assets and is subsequently associated with a privilege to water.
4. Right to sufficient way of life: can't be acknowledged without a protected access to water.
5. Right to lodging: As the CESCR expressed "the privilege to sufficient lodging should have manageable access to characteristic and normal assets, safe drinking water, sanitation and washing offices".

6. Right to instruction: The absence of appropriate supply of water powers youngsters to walk long separates, regularly a few times each day - in this manner they miss the classes to give their families water.
7. Right to partake in social life: The pulverization, confiscation or contamination of water-related social locales speaks to an inability to find a way to protect the social character of different ethnic gatherings.

In Africa, sub-Saharan Africa, higher-pay family units with associations with utilities get the best gains from water sold at costs far underneath the level expected to take care of activities and support costs (World Bank, 2014).

Individuals living in the ghettos of Kenya pay five to multiple times more for water per unit than those in high-salary regions and more than shoppers pay in London or New York (England, 2012). In Benin, Kenya and Uganda, association expenses for access to water arrangement from formal system suppliers surpasses US\$100 in 2008, guide duties for huge sanitation and drinking water frameworks was US\$4.6 billion, contrasted with US\$1.2 billion in help to fundamental frameworks (UNFPA, 2011). Fundamental drinking water frameworks are characterized as drinking water supply through ease advances, for example, hand siphons, spring catchment, gravity-sustained frameworks, water gathering, stockpiling tanks and little circulation frameworks. Essential sanitation frameworks are characterized as lavatories, little bore sewers and on location transfer. Enormous drinking water frameworks incorporate treatment, drinking water transport and dispersion and huge sanitation frameworks incorporate sewerage accumulation frameworks and wastewater treatment plants (UN - Water, 2012; UNFPA, 2011; WHO, 2015).

On great days, the ladies and offspring of Kibera go through simply under an hour finding a water merchant, lining up, and conveying back the water. They will pay Ksh 2-3 for every 20-liter (4 gallon) jerry container of water from any of the 650 water merchants in Kibera,

generally 98% of which are private endeavors and 20 that are controlled by network-based associations or NGOs (Njogu, 2015). The Nairobi Water and Sewage Company prescribes that the cost for a jerry jar of water be Ksh 1, so even at Ksh 2, inhabitants of Kibera pay multiple times the most reduced tax at household associations and multiple times the normal duty in Kenya (World Bank, 2014). In certain towns, up to 85% of family units are assessed to depend on these private and network possessed water booths (Chung, 2011).

At the point when there is a deficiency, which happens four times each month overall, the cost of water skyrockets to Ksh 5-10 and even up to Ksh 30 for every jerry can (Kimotho, 2012). On nowadays, ladies and offspring of Kibera can go through throughout the day searching for water. In the event that they can't discover clean water or if the cost of water is excessively high, they will expend inadequate water from a free yard tap or regular spring the vast majority of which, if not all, are sullied and dangerous for drinking (Shelmith, 2016).

A significant number of the reasons why water is so costly is outside the control of water sellers, for example, the proportioning of water three times each week by the Nairobi Water Company, and the high capital expenses of brokers for instance laying funnels and paying influences, the last which is supposedly a fourth of starting speculation costs, (United Nations, 2016). Be that as it may, water and other utility administrations in Kibera have been known to be constrained by neighborhood packs and cartels, who frequently connive with utility authorities to make counterfeit deficiencies for quick benefits. High costs are likewise made conceivable by the grouping of water deals to a select number of stands. A World Bank study, (2014), for example, demonstrated that 66% of the water sold in Kibera over a seven-day time span originated from 29% all things considered.

On the off chance that the base of water issues in Kibera fixated on cost and supply it might be reasonable, yet issues of water quality considerably entangle clean water conveyance frameworks. Most water pipes in Kibera keep running over the ground and are made of plastic, because of issues with burglary of steel channels, which are exceptionally delicate and effectively controlled (UNFPA, 2011). These channels will frequently split or break, either inadvertently because of traffic or purposefully by contenders, enabling sewage to saturate drinking water. For sure, water sources that are commonly perfect can undoubtedly wind up polluted without notice. This is reflected in general wellbeing information baby death rates and ridiculous diarrheal disease rates in Kibera are multiple occasions the normal of Nairobi all in all (Njogu, 2015).

2.4 Water quality

The circumstance of access to clean water in country Africa is significantly more horrid than the past measurements suggest. The Halilu and Kuta, (2015) expressed that, in 2011, just 19% of individuals in sub-Saharan Africa approached drinking water through a family unit association (an indoor tap or a tap in the yard). Not exclusively is there poor access to promptly open drinking water, notwithstanding when water is accessible in these communities, there are dangers of defilement because of a few variables. At the point when wells are manufactured and water sanitation offices are created, they are inappropriately kept up to because of constrained monetary assets. Water quality testing isn't executed as regularly as is important, and absence of training among the individuals using the water source persuades that as long as they are getting water from a well, it is sheltered. When a wellspring of water has been given, amount of water is frequently given more consideration than nature of water (Magombo, 2016).

There are restricted wellsprings of water accessible to give clean drinking water to the whole populace of Africa. Surface water sources are frequently exceptionally dirtied, and framework to pipe water from crisp, clean sources to bone-dry territories is excessively expensive of an undertaking (Ademun, 2009). Groundwater is the best asset to tap to give clean water to most of regions in Africa, particularly country Africa, and groundwater has the advantage of being normally shielded from bacterial pollution and is a dependable source during dry spells. In any case, the surprising expenses related with boring for water, and the specialized difficulties in discovering sources that are huge enough to serve the populace out of luck, present difficulties that point of confinement tapping the asset (Adeleke., et al., 2014). Groundwater isn't a safeguard asset, either, with regards to giving clean water. There might be pollution of the water with overwhelming metals, and microorganisms might be presented by releasing septic frameworks or debased wells. Consequently, it is significant that groundwater be checked often, which is exorbitant and requires specialized capacities that may not be available in provincial territories (Ondieki and Kebaso, 2017).

As of now, water quality norms and checking in Kenya cling to the WHO rules as gave in the Kenyan water quality measures created by the Kenya Bureau of Standards (Davies and Gustafsson, 2015).

1. The Ministry of Health has the general command for cleanliness training and fundamental sanitation where offices don't depend on sewerage frameworks, for example, pit restrooms which are prevalent in Kibera.

2. Currently there is little consideration paid to water quality checking or guaranteeing that occupants of Kibera have adequate and dependable data on the dangers related with dangerous water.
3. The decision of water filtration procedures is frequently made with no data on the water quality, which has genuine wellbeing suggestions for the inhabitants.

Kibera is portrayed by a system of awkward plastic water pipe associations (spaghetti systems) (German participation, 2017). These channels regularly burst, presenting occupants to the danger of pollution. The greater part of the associations in Kibera are finished by 1-inch width type funnels. The releasing channel and taps are ½ inch in width and most have just one tap for every drawing point. This adds to long lines (Onjala, 2012).

2.5 Water quantity

A large portion of the earth comprises of water, there is significantly more water than there is land. About 70% of the world's surface is canvassed in water. Every year, 119.000 km³ of water hastens ashore and 74.200 km³ vanish into the air, by evapotranspiration from soil and vegetation (UN, 2013). Of the freshwater on Earth, about 2.200 km³ streams in the ground, generally inside a large portion of a mile from the surface. About 135.000 km³ of water can be found in the environment as water vapor, in lakes, soil dampness, swamps and wetlands, waterways, plant and creatures (Kaushik, et al., 2015). Groundwater and crisp water put away in surface bodies and in the climate speak to an accessible asset of new water. The vast majority of the freshwater is put away in ice sheets and icecaps, for the most part in the Polar Regions and in Greenland, and it is inaccessible. This is another 24.500.000 km³ of water, framing the 69.5 % of the all-out new water of the Earth. Of all the water on earth, which is 97.14% of the aggregate sum of surface water, just 2.59% is freshwater. Of this 2.59% another rate is caught in ice tops and icy masses, which is about 2%. The

remainder of the freshwater is either groundwater (0,592%), or promptly open water in lakes, streams, waterways, and so on (0.014%) (WHO/UNICEF, 2015).

The water you drink today has likely been around in some structure since dinosaurs meandered the Earth, a huge number of years prior. While the measure of freshwater on the planet has remained genuinely steady after some time constantly reused through the environment and once more into our cups the populace has detonated (Yongsi, 2010). This implies each year rivalry for a spotless, bountiful supply of water for drinking, cooking, washing, and supporting life escalates. Water shortage is a dynamic idea to numerous and an obvious reality for other people. It is the aftereffect of heap ecological, political, financial, and social powers (Rono, 2013).

Freshwater makes up a little portion of all water on the planet. While about 70 percent of the world is secured by water, just 2.5 percent of it is new. The rest is saline and sea based. And, after its all said and done, only 1 percent of our freshwater is effectively open, with quite a bit of it caught in icy masses and snowfields (WHO/UNICEF, 2010). Fundamentally, just 0.007 percent of the planet's water is accessible to fuel and bolster its 6.8 billion individuals. Because of geology, atmosphere, building, guideline, and rivalry for assets, a few locales appear to be moderately flush with freshwater, while others face dry spell and weakening contamination. In a great part of the creating scene, clean water is either difficult to find or an item that requires arduous work or noteworthy cash to acquire (United Nations, 2016).

A large number of the most water-rare nations as of now have profoundly viable water system frameworks, so this won't considerably diminish their requirements for advancement

of extra water supplies. Then again, the greater part of the world's increase in water system viability would be in nations with a high level of rice water system. It isn't clear how much bowl water system viability can be basically expanded in rice water system (Chowns, 2014). Likewise, rice water system will in general happen in regions with high precipitation where water supply is certainly not a noteworthy issue. The way that South China has a great deal of water to be spared through improved water system viability is little reassurance to a rancher in Senegal who barely has any or so far as that is concerned to a rancher in the parched north of China (except if there are bury bowl moves from south to north). Mostly consequently, one-portion of the world's all out evaluated water reserve funds from expanded water system viability is in India and China. This represents why the nation information and, at last, the information for areas inside nations are considerably more significant than world information (WHO, 2015).

Africa's water assets are dispersed all through the mainland. While a few zones get all that could possibly be needed water, others experience consistent dry season. In the Horn of Africa and the Namibian Desert, no cascades. In the meantime, the western piece of the landmass close to the equator gets as much as 4,000 millimeters every year (German collaboration, 2017). Most of the mainland falls somewhere close to these two boundaries. Normal territories get somewhere in the range of 200 to 800 millimeters of yearly precipitation. Tragically for a significant number of the plants and creatures in the zone, dry spells are normal. Dry seasons enduring as long as five years are a typical issue on the mainland. Three of four Africans utilize the ground water as their primary water supply. The ground-water isn't constantly accessible however as it represents just 15% of the landmass' water supply. There are additionally genuine worries about the nature of the groundwater (UN - Water, 2012).

Maybe the best reason for Africa's concern of an absence of water is that the mainland can't successfully use its assets. In spite of the fact that around 4 trillion cubic meters of water is

accessible consistently, just about 4% of that is utilized. The mainland and its kin do not have the specialized information and monetary assets expected to get to their water supplies (UNICEF, 2009). Notwithstanding its area along the equator, Kenya faces extraordinary varieties in atmosphere because of its different landforms, especially the Rift Valley. The variable atmosphere brings visit dry seasons just as floods. Precipitation is unevenly appropriated all through the nation, with under 200 mm/yr falling in northern Kenya (WHO/UNICEF, 2017). Surface water assets are likewise restricted, covering just two percent of Kenya's all out surface region. Effectively putting away and conveying officially extended water assets has demonstrated to be a test, leaving the part helpless against climatic varieties. What's more, the disintegration and sedimentation that pursue Kenya's incessant flood occasions make improved catchment the executives troublesome. Kenya has been distinguished as confronting a mind-boggling water assets emergency emerging from the accompanying circumstances (UN, 2013)

1. An incredibly restricted yearly inexhaustible crisp water asset per Capita.
2. A quickly developing interest for water for multi-sectoral utilizes, from one viewpoint, and reduction of characteristic stockpiling limit and absence of improvement of fake stockpiling ability to satisfy need and to cradle against stuns.
3. Sharing of over portion of waterways, lakes and springs with neighboring nations, that confounds the board of these water assets with suggestions for local security and improvement (WHO/UNICEF, 2015).

2.6 Theoretical Framework

2.6.1 Pareto Efficient Theory

An audit of the appropriate writing demonstrates that a wide Corresponding writer JEL

Classification Codes: D4. O5 scope of techniques for valuing water has been created after

may not be suitable as for proficiency purposes. For example, a Rawlsian idea of reasonableness to examine value in India's water system frameworks is utilized by Sampath (1992). It tries to amplify the welfare of the wealthy minority in a general public and enables one to assess change techniques in these terms (Johansson, 2000). Water valuing components are for the most part in the national intrigue and are utilized to expand water accessible for specific divisions or natives (Johansson 2000). They are not, in any case, powerful in redistributing salary.

Dinar et al., (1997) guaranteed that to meet this objective, it is regularly important to give a financed water arrangement or receive distinctive evaluating systems representing different salary levels.

2.6.2 Environmental Discourse theory

The environmental discourse: The theorist Brulle came up with nine distinct environmental discourses, to which, in some cases the global water crisis relates. The manifest destiny discourse focuses on the fact that exploitation and development of natural resources gives the environment value, directly relates to the water crisis in that the constant human activity like mining and agriculture which may give the environment value, in turn destructs the environment and has a considerable effect on vital resources like water. The conservation discourse reveals that natural resources should be technically managed from a utilitarian perspective; this discourse in particular reflects the action taken by governments and the global population in the twenty first century, as the realization and reality of the water crisis has become clearer and concerning, as well as, the process as conserving water has become more prevalent and encouraged. Reform environmentalism discourse states that ecosystems must be protected for human health reasons, although the water crisis does not compliment this discourse to a large extent, the discourse does allow one to consider the following: when

one considers water an important resource and thus needs to be protected and conserved to prevent it from becoming infected or polluted and thus becoming a health threat to those who demand and consume it. (Hannigan, J. 1995, Chapter three: Environmental discourse. In: Environmental sociology. New York: Routledge)

The fact that a number of communities do not have access to fresh drinking water or their source of water has been infected due to mismanagement or irresponsibility is supported by the environmental justice discourse. The environmental justice discourse states that ecological problems reflect and are a product of fundamental social inequalities. The municipality of certain areas in South Africa is to blame for contaminated water sources or polluted waters as their lack of service and infrastructure has resulted in these various water problems and thus disequilibrium in demand for water. Eco-theology, states that humans have an obligation and to preserve and protect nature since it is divinely created, water is a vital resource and is needed to sustain life on earth thus it is up to the present population to rectify the global water crisis and discover and develop appropriate, sustainable and long-term solutions. "The power imbalances inherent in the global economic system lead to situations where lower income residents are differently impacted environmentally" this theory which comes under environmental justice, is particularly relevant when considering the water crisis because it is the poorer countries and people that as a result of a lack of infrastructure and inefficient government rule that the various populations do not have access to clean and safe drinking water, particularly evident in African countries and countries like India.

Ecosystem discourse which has been developed on the view of: human interference in biotic communities upsets the balance of nature. This discourse in particular links with the global water crisis in that the growth of urbanism, population and industry which is discussed in terms of this discourse has had and will continue to have a negative effect on the availability

and quality of water and water sources globally. An increase in urbanism and industry, and complimentary an increase in population has resulted in increased pollution, construction, and in general environmental destruction. There are more people dependent on the earth's resources, and in particular developments in technology have resulted in an increase in demand for resources like water. (Hannigan, J. 1995. Chapter three: Environmental discourse. In: Environmental sociology. New York: Routledge)

2.7 Conceptual Framework

The environmental discourse theory describes challenges related to water in a given place. Narrowing down to Kibera slum which will be the area of study, the following mechanisms can be used to address challenges related to water quality, water affordability, water quantity and water accessibility in the area.

Independent Variables

Dependent Variables

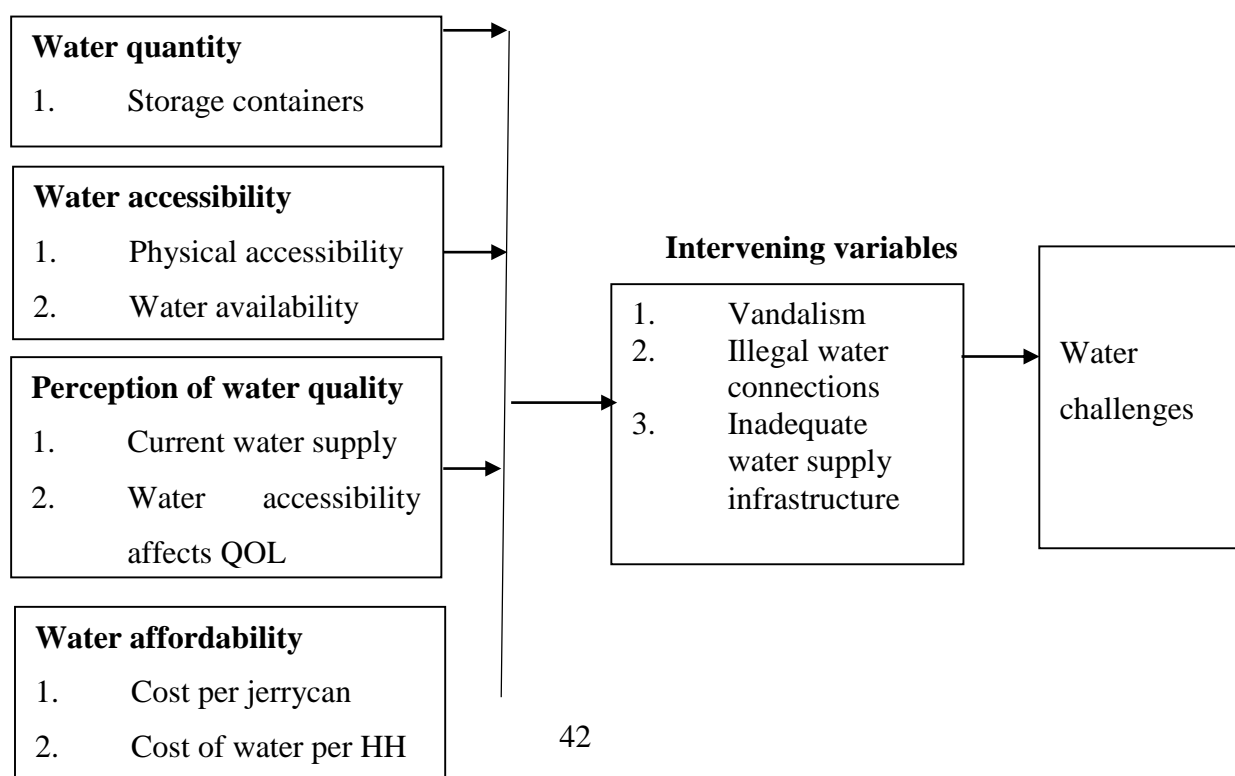




Figure 2. 1: Conceptual Framework

Source; from literature review by researcher

The conceptual framework (Figure 2.1) summarises the concepts of water availability and accessibility in households. Water in the household is determined by distance, time taken to the water source and the quality of water. These factors are influenced by harmful risks such as availability risks (climatic shocks and deforestations), access risks (corruption and poor policies) and usage maximization risks (include institution failures, lack of inputs and knowledge). These risks contribute to poor water availability and accessibility, resulting to unsustainable livelihoods and poor health, hence need for mitigation measures and efforts to make sure that water is available to the people, such measures include good water sources management practices, adequate funding, incorporation of the local community among others. This leads to water availability and accessibility through increased supply of water, good watershed management and proper investment in water sources such as boreholes.

Secondly, improved distribution of water sources, which involves proper channelling and appropriate investments such as laying of water pipes, water tracking and sinking boreholes. Lastly, meeting the demand of the people based on proper allocation principles, incentives and good practice. Cumulatively this will ensure safe, clean and reliable water is available, accessible and ready to be used for human consumption contributing to sustainable livelihood and improved health in the households. This constitutes household water which translates to improved and sustainable livelihoods as well as poverty reduction.

2.8 Knowledge Gap

Documented research findings have observed that several challenges inform the used of water in the households for domestic chores in informal settlements. Some of the gaps identified in the

existing research literature especially the study of Kaushik, et al., (2015) and the study of Ondieki and Kebaso, (2017) include challenges arising from low income among slum dwellers and low investment and maintenances of existing water infrastructure as a factor of lack of affordability and low access to quality water demand and high network.

losses. Kaushik, et al., (2015) gave a general conclusion about the growing water demand and unsustainable use of the natural resources without specifying the level of household water demand and the actual population still living without access to safe drinking water supply and how to manage the unsustainable use of the finite resource. What is not clear in the literature is whether the deteriorating access of improved water is the result of physical water shortage, infrastructural constraints, mismanagement or inadequate human and institutional capabilities to tackle the situation. With a view to contributing to such knowledge this study aims to analyze and determined the magnitude of household access to improved water demand and distribution coverage, challenges that contribute to deteriorating access to quality water demand and the effectiveness of the current water use management strategies. The management of the water supply serving the Sub-County has also had an effect on the availability and safety of water here. Water availability and safety has also been affected by the now almost regular droughts which bring about water scarcity. The information on the availability and safety of water in Kibera slums is scant. Several studies have been carried out here but none has concentrated on the issue of water availability challenges.

CHAPTER THREE: METHODOLOGY

3.0 Introduction

This chapter specifies various methods and procedure that was used to conduct the research. It is organized as follows: research design, study area, target population, sample size and sampling procedures, data collection methods and procedures, data analysis techniques, ethical issues and operational definition of variables.

3.1 Study Area

3.1.1 Study Area Profile

Kibera slum is a division of Nairobi County, and neighborhood of the city of Nairobi, located 5 kilometers from the city centre. It is the largest slum in Nairobi, and the largest urban slum in Africa. It is estimated to be a home of 800,000 people or a third of Nairobi City County residents.

The neighborhood is divided into a number of villages, including Kianda, Soweto East, Raila, Kisumu Ndogo, Lindi, Soweto West, Kambi Muru, Laini Saba, Silanga, Kichinjio, Gatwera, Makina and Mashimoni. Conditions in Kibera are extremely poor, and most of its resident's lack access to basic services, including electricity and running water. In 1912, Kibera was a settlement in a forest outside Nairobi; as a result of World War I, it became a resettlement area for Nubian soldiers returning from service. The colonial government then, allowed settlements to grow and opened gates to other tribes from across the country.

Kibera is significant and rapidly growing part of the world's population, service provision and the growth of institutions in these areas is of great significance to well-being. Water in Kibera is scarce and costly, and its supply uncertain, women and others collecting water for

their households spend hours searching for vendors with water, queuing up, and then walking home with 50 lb containers carrying water. One estimate suggests that households spend 20% of their income on water (UNDP 2016). Women interviewed say they frequently curtail clothes-washing, often postpone baths, and sometimes have fewer meals, when water is unavailable or unaffordable. The reproduction of inadequate water access in Kibera involves social relations which are not fully captured by ideas of corruption, water mandarins, or water mafias (APHRC, 2014).

Burdensome access to water in this huge and complex city arises from at least three interlocking factors: the unwillingness of the postcolonial government to accept the legitimacy of the growing settlements it inherited, the unregulated context of vendors and landlords building enterprise on shaky rights, and the rise and fall of gangs and cartels operating with connections to city government.

3.1.2 The Physical Setup

Kibera is located southwest of Nairobi city centre. Its geographical co-ordinates are 1 degree 19minutes 14 south and 36 47 34 East. It is sited approximately 5km southwest of the city centre. Much of its southern border is bounded by the Nairobi River and the Nairobi Dam, an artificial lake that provides drinking water to the residents of the city. Kibera as a whole is an informal settlement comprising of thirteen villages covering approximately 250 hectares of land with an average population density of 2000 people per hectare although some villages are more crowded than others. Kibera slums was chosen out of 160 informal settlements in Nairobi through simple random sampling

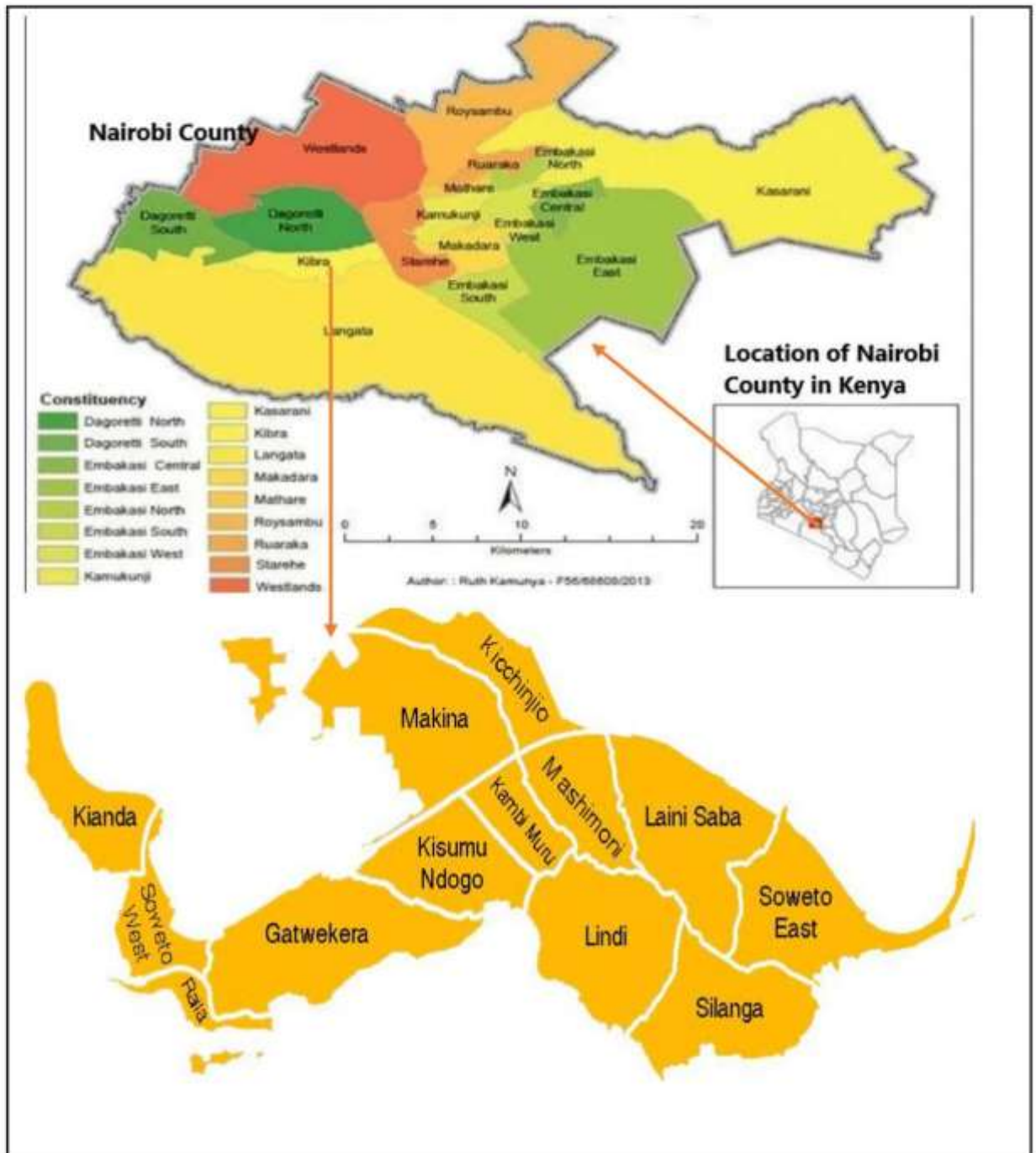


Figure 3. 1: A map showing the location of the study area in Nairobi County.

Source; adopted from google map at <https://www.google.com/search?client=opera&hs=WB0&biw=1326&bih=626&tbm=isch&sxsrf=ACYBGNOzCHCJIs0nnMkKTC-v7IGEZovZCQ%3A1574700769408&sa=1&ei=4QbcXcfGGLC91fAPkOW42Ao&q> on

3rd April 2019

3.1.3 Topography and Drainage

Kibera generally comprises of steep hills and river valleys which ensures that the railway line that cuts across the slum had cut through a section of the hilly terrain creating steep trenches that drain the site to the Nairobi dam situated on the periphery of the slum. Kibera is mainly covered by fertile red soils. The areas around Nairobi river banks are generally good for agriculture but due to pollution of the water in the river, very little cultivation is carried out near the river banks.

3.1.4 Climate

Kibera neighbourhood presents a microclimate of Nairobi city which lies one third degrees south of the equator thus expected to experience an equatorial climate. But due to the Cities altitude of about 5,500 feet above sea level, the climate is similar to that of low latitude highlands. The site enjoys a fairly moderate climate that is very attractive for human habitation. The altitude makes the area chilly in the mornings especially in the months of June to October which is usually cloudy and misty with temperatures dropping to about 12° C. Temperatures are highest in the months of December to March dominated by strong north east monsoon winds just before the first rain season and lowest in the months of June to August accompanied by cold south east monsoon winds resulting to an annual mean temperature of 17° C. The area experiences two rainy seasons, (March to May: long rain season usually cloudy and October to December: short rain season) amounting to an annual rainfall of about 1,200mm. Nairobi being located close to the equator makes the difference between the seasons minimal: Dry and wet seasons. The sun rise and sun set do not vary tremendously for the same reasons.

3.1.5 The Economic Set Up

3.1.5.1 Agriculture

A local organic farming company Green Dreams has been documenting the progress of transforming a garbage dump to an organic farm on the Green Dreams blog. They are working with a local youth group comprising reformed criminals in converting garbage into organic manure, and garbage dumps into organic farms. Using very small plots of land, about fifty square meters, and double dug beds, the farmers can raise seeds very quickly. Fast-growing varieties like amarynth and spider plant take only about three months to produce seeds, with about 3,000 Kenyan shillings in profit. The future for these farmers continues to be uncertain. Their land could be taken away, the drought could further jeopardize their crops, and the loss of wastewater for fertilizer could reduce production; but they continue to persevere despite these challenges' thanks, in part, to the work of groups like Urban Harvest and the Mazingira Institute.

3.1.5.2 Trade, Commerce and Industry

Majority of the inhabitants are workers in middle and high-income homes in the nearby Lavington, Highrise estates and Langata estates. Others are casual laborers in the factories the nearby industrial area. Most of these according to Syaga *et al.*, (2010) earn an average of \$2 a day. There are exemptions of well-trained people who cannot afford better housing in other parts of the city. Some professionals have been forced into the slums following economic downturn. There exist NGOs and CBOs that are supporting groups in undertaking small scale businesses through revolving funds. Small women groups' through Merry-go-around are raising funds and assisting members to raise funds. Water projects are raising funds (sale of water) for example Maji na Usafi NGO.

Some of the residents make a living by growing vegetables at the river bank near the dam and selling them. Some rear goats and chickens to make. Several residents raise poultry and goats, but the City Council has prohibited livestock husbandry. Animals have occasionally been confiscated and exorbitant fines exacted to secure their release.

3.1.6 The Social Set Up

Kibera slum is thickly populated with 95% of the occupants living beneath neediness line. The majority of them are working in the mechanical territory of the city as easy-going workers with a normal pay of Kshs 45/= every day. The normal group of 7 consumes a little room of 10 by 10 feet. There are no road lights. The vast majority of the houses are made of mud and roofed with either folded iron sheets or secured with polythene paper. Kibera inhabitants comprise of various ethnic networks as implied before on. The vast majority of them have gone to the city to search for practical vocations. In case of social clashes in the region, ethnic responses will in general erupt particularly between the first Nubian people group on one hand and other nearby ethnic gatherings. Kenya's water assets emergency conveys huge social dangers. Developing interest over constrained enrichment of water produces rivalry and causes clashes over water use inside the town, presenting significant social dangers to poor people and the networks without satisfactory portrayal in the area in basic leadership.

The Kibera informal settlement has continued to grow since 1970. During the 1970s it started booming with its population increasing from an estimated 6000 inhabitants in 1965 to 62,000 in 1980, 248,360 in 1992, and 500,000 in 1998, and 800000 in 2017 with an estimated growth rate of 17.2% per year according to the United Nations-Kenya, (2018).

3.2 Study Design

This was a descriptive cross-sectional study. The study used quantitative design through the use of an interviewer administered semi structured questionnaire. In a cross-sectional study, data are collected on the whole study population at a single point in time to examine the relationship between variables.

3.3 Research Design

The research design is the conceptual structure within which research is conducted. The study used quantitative design through the use of an interviewer administered semi structured questionnaire. This design used an analytical as a tool to organize data into patterns that emerge during analysis. This is because it is ideal in identifying hypothetical constructs and can thus acquire a lot of information through description.

3.4 Study Population

The study population was households heads or residents over 18 years in Kibera slums, the study area has approximately 170,070 households (United Nations-Kenya, 2018).

3.5 Selection Criteria

3.5.1 Inclusion criteria

- a) Household heads or adults over 18 years residing in the study villages
- b) Respondents who gave a written informed consent

3.5.2 Exclusion Criteria

- a) Respondents of unsound mind whom were known through problems with concentration, speech that are hard to explain and uncharacteristic.

3.6 Sampling Procedures

The study adopted a multistage sampling technique, random sampling among the Nairobi informal settlements was employed to select Kibera informal settlements, then the final subjects proportionally selected from the various strata, Kibera Constituency was selected.

3.6.1 Sample Size for Quantitative Data

Cochran (1977) sample calculation is a way to determine the sample size for a study. It is the most ideal method to use.

The Cochran formula is:

$$n_0 = \frac{Z^2 pq}{e^2}$$

Where:

- e is the desired level of precision (i.e. the margin of error),
- p is the (estimated) proportion of the population which has the attribute in question, a 50% rate will be used
- q is 1 – p.

$$n = \frac{(1.96)^2(0.5)(1-0.5)}{(0.05)^2} = 384$$

3.6.2 Qualitative Data

It was determined using the data saturation method. Saturation is data satisfaction. It is when the researcher reaches a point where no new information is obtained from further data. Saturation point determines the sample size in qualitative research as it indicated that adequate data has been collected for a detailed analysis.

3.6.3 Sampling Method for quantitative data

The villages at Kibera slums were selected using simple random sampling and seven villages were selected through proportional sampling

The number of respondents recruited per village are indicated below:

Table 3. 1: Proportional sampling

Study area	Estimated No. of HH	Sample size
Kianda	11569	48
Kisumu Ndogo	12776	53
Lindi	12946	53
Soweto West	13883	57
Laini Saba	13153	54
Gatwekera	14327	59
Makina	14563	60
Total	93217	384

Source KNBS 2016

The number of the respondents in each village was allocated proportionally using the number of the household. The selected number of household heads or residents over 18 years was sampled conveniently in each household through systematic sampling technique.

3.6.4 Purposive sample for Qualitative Data (Key Informants)

The sample size for qualitative data was arrived at after considering the various actors and participants of the water supply. Two categories of actors were informed the choice of participants for qualitative data. Purposive sampling was used to collect data from KII to further understand water supply.

Table 3. 2: Sample Size for Qualitative Data (Key Informants)

	Key informants	Sample size
1	Water resource user associations (WRUAs)	5
2	Water services providers (WSPs)	3
3	Catchment areas advisory committees (CAACs)	3
4	Water resource management authority (WRMA)	3
5	Water service regulatory boards (WSRB)	3
	TOTAL	17

3.7 Methods of Data Collection

This study employed various methods of data collection

3.7.1 Questionnaires

One types of questionnaire was used to collect data from household heads. The structured and semi structured open and closed questions was used in the questionnaires. The semi structure open end questions allowed the interviewee to explain freely about the subject at hand. 'The questionnaire allows for feedback from large number of people, where it is impractical to collect feedback using other more resources intensive methods. At the same it allows each respondent the opportunity to provide anonymous feedback on their experience'.

3.7.2 Checklists

Checklists was used to verify the equipment's in place for water storage.

3.7.3 Key Informant Interview

Key informants were purposively selected to give an advantage to the moderator to probe for more in depth analysis and ask professionals to elaborate more on their efforts in maintaining water supply

3.7.4 Observation

Observation is a technique which involves systematic selecting, watching and recording behavior, characteristics, availability and status of an object or phenomena; it gives more additional accurate information to the study. On this study the observations played a big part in confirming the availability and status of water availability at Kibera slums.

3.8 Methods of Data Collection

3.8.1 Pre-Testing

A pre-testing was carried out at Mashimoni village, it included 10% of sample size (Mugenda and Mugenda 2003) and the respondents were not included in the study, pretesting was done to verify the validity of questionnaire and to ensure that questions were easily understood, assess the flow of variables in the questionnaire, difficulties of obtaining information and other important aspects and do the changes accordingly to fit the study. Pre-test was done at least 1 week before the actual data collection begun to check the consistency.

3.8.2 Data Collection.

Two research assistants in each study village who were the residents of the slums were identified and hired. They were trained by the researcher both on how to sample and administer the questionnaire. The respondents were sampled at the time of interview and effort were made to get first-hand information from them about their lives including

housing, electricity, water usage etc. The assistants were visiting each household systematically and identify the respondents. Initially the respondents were expected to fill in answers themselves after reading questions carefully but where they were unable to understand, the assistants were allowed to explain by translating the questions to local vernacular or Swahili. The assistants also requested to consider gender equality and the selected respondents had to be household heads.

3.9 Data Analysis

Once data is collected, it was edited to ensure consistency across the respondents and location of any omissions, it was summarized, coded and entered into a computer. Data analysis was conducted using SPSS statistical software. Quantitative data was coded and processed using SPSS version 25.0. Descriptive statistics such as frequencies, standard deviation and means was used to summarize, organize and simplify the data collected. Correlation analysis was employed to test the relationship between dependent and independent variables. A significance level of 0.05 was used. On bivariate analysis, all independent variables were associated with the dependent variable to determine which ones have significant association. Odds Ratio (OR) and 95% Confidence Interval (CI) was used to estimate the strength of association between independent variables and the dependent variable. The threshold for statistical significance was set at $\alpha = 0.05$ and a two-sided p value at 95% confidence intervals (CI) reported for corresponding analysis. On multivariate analysis, all independent variables identified to significantly associated at bivariate analysis was considered together in a multivariate analysis. This was performed using Binary logistic. Adjusted odds Ratios (AOR) together with their respective 95% Confidence Interval (CI) was used to estimate the strength of association between the retained independent variable.

Qualitative data generated from KI inform of notes (responses) from the participant's was cleaned and coded manually based on themes developed from responses (thematic analysis) in accordance with the research objectives and reported in narrative form and additionally used to reinforce quantitative data.

3.10 Ethical Considerations of the Study

To conduct this study, approvals was requested from University of Nairobi graduate school, ethical approval from KNH/UON-ERC and permit from National Committee of Science, Technology and Innovation to take to relevant authorities at Nairobi county. Approvals from Nairobi city county and Kibera sub-county as well as local administrations were also sought. Informed consent was obtained from the respondents. The right to participate in the study or not were rested with the respondents and this was always be respected at all times during the study. Respondents were informed that it is their right to choose whether to participate in the study or not and even withdraw from the study at any time. No inducements or rewards were given to participants to join the study. Confidentiality and anonymity were maintained at all times. No identifying data was recorded and all information given was used strictly for research purposes only and data collected was stored, analysed and reported in formats that won't allow identification of the individual participant. There were no invasive procedures carried out on the participants, so no physical risks were encountered.

CHAPTER FOUR: RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter provides a presentation of the findings, interpretations together with the discussions. The purpose of the study was to identify challenges related to availability of water among residents of Kibera slums, in Nairobi City County. The findings of the study are presented in tables, charts, and graphs.

4.2 Response Rate

A total of 384 structured questionnaires were administered in tandem with the calculated sample size, of which 4 questionnaires were incompletely filled and 16 respondents declined to consent for the study, therefore the response rate was 94.8% of the required sample size as shown in table 4.1 below.

Table 4. 1: Response Rate

Study Area	Estimated sample size	Sample size	Response rate
Kianda	48	48	100.0%
Kisumu Ndogo	53	51	96.2%
Lindi	53	52	98.1%
Soweto West	57	54	94.7%
Laini Saba	54	49	90.7%
Gatwekera	59	53	89.8%
Makina	60	57	95.0%
TOTAL	384	364	94.8%

4.3 Demographic Characteristics of the Respondents

4.3.1 Socio-Demographic Characteristics

The respondents age ranged from 20 years to 26 years, the mode was 26 years, median 29.00

respondents were of between age 25-29, 129(35.4%) followed by age 30-34 (29.1%). This implies majority of people living in the settlement are in youthful stage. This age group is also important for creating ready work force. On gender distribution of the respondents. The number of female respondents was higher than that of male. Out of the sample of 364, 186(51.1%) of the respondents were females while 178(48.9%) were males. More than half of the respondents 209(57.4%) were not in marital union at the time of the study as illustrated in table 4.2.

This implies majority of people living in the settlement are in youthful stage. This age group is also important for creating ready work force. The gender representation of the respondents was slightly skewed with women being more than the men by 2%. This was perhaps since the interview was conducted during the day and men who are mainly regarded as bread winners in many families were out of the settlement for job.

Table 4. 2: Socio-Demographic Characteristics

Characteristics		Frequency	Percent
Age	Less than 25 years	57	15.7%
	25-29 years	129	35.4%
	30-34 years	106	29.1%
	35-39 years	34	9.3%
	40 years and above	38	10.4%
Gender	Male	178	48.9%
	Female	186	51.1%
Marital status	Single	147	40.4%
	Married	155	42.6%
	Separated	48	13.2%
	Divorced	4	1.1%
	Widowed	10	2.7%

4.3.2 Socio-Economic Characteristics

More than half 230(63.2%) of respondents had primary education with majority of the respondents 211(58.0%) were unemployed. On terms of spouse occupation, slightly less than half 68(43.9) of the spouses were self-employed, 47(30.3%) had no occupation while 40(25.8%) were employed and 161(44.2%) had a monthly income of less than Ksh 5000 as shown in table 4.3.

This meant that most of the respondents were able to understand how the water usage would have influenced their livelihood. Further, the greatest number of respondents depended on self-employment (43.9%). This implies that most of respondents were low income earners depending on temporary jobs and small-scale businesses.

Table 4. 3: Socio-Economic Characteristics

Characteristics		Frequency	Percent
Level of education	No formal education	24	6.6%
	Primary	230	63.2%
	Secondary	97	26.6%
	Tertiary	13	3.6%
Occupation	Student	23	6.3%
	Self-employed	74	20.3%
	Unemployed	211	58.0%
	Employed	56	15.4%
Spouse occupation	Self-employed	68	43.9%
	Unemployed	47	30.3%
	Employed	40	25.8%
Monthly income	Less than Ksh 5000	161	44.2%
	Ksh 5000-10000	96	26.4%
	Ksh 11000-20000	45	12.4%
	Ksh 21000-30000	36	9.9%
	More than Ksh 30000	26	7.1%

4.3.3 Period of residence

Most of the respondents in Kibera 140(38.5%) slums had been settled in their areas for 10 years and above. The rest of the respondents had been living for between 7 and 9 years 94(25.8%). About 9% of the respondents in Kibera had lived there for 1-3 years.

Table 4. 4: Period of residence

Characteristic		Frequency	Percent
Duration at study area	Less than 1 year	35	9.6%
	1-3 years	33	9.1%
	4-6 years	62	17.0%
	7-9 years	94	25.8%
	10 years and above	140	38.5%

4.4 Accessibility of The Water Supplied to Residents

4.4.1 Main Sources of Water in Kibera

Water is a basic human right and access to it should be a basic human right as well. The right of access to water resources is enshrined in the National Constitution and in the Water Act 2002. Access to water is an equally important factor in demand for water. Timely and easy access to water should be considered as a basic right that should be guaranteed for all. The study, therefore, sought to find out the average walking distance to the nearest water point for every household and the findings found that most of respondents 108(29.7%) were now accessing water from the kiosks and 105(28.8%) from shared tap. This is shown in figure 4.1.

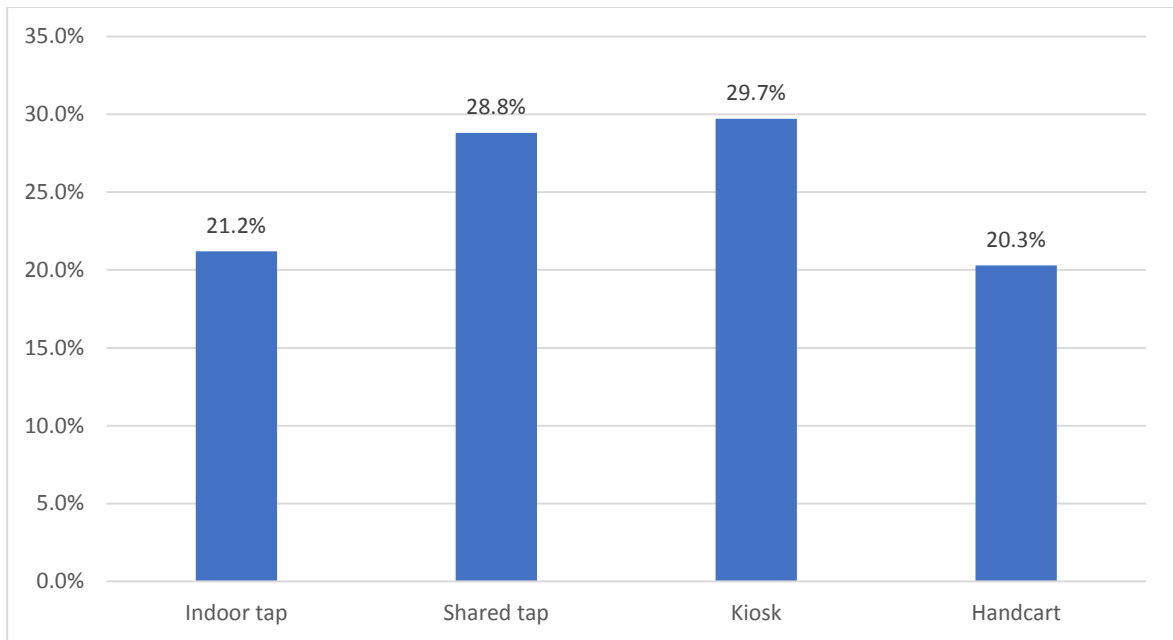


Figure 4. 1: Main Sources of Water in Kibera

This is in agreement with Kennedy, (2016) study that found 34% of Kenyans living in informal settlement are reported as having access to water through kiosk and 25% from community shared piped water. The study further revealed that majority of taps were vandalised in informal settlement. These were taps set up by the Nairobi Water and Sewerage Company (NCWSC) at strategic points from the main water network connection. The dependency on this source was low since most of the time such taps are vandalized as well as frequently diverted to illegal connections. 8% of households relied on piped water directly into their households from the Nairobi City Water and Sewerage Company (NCWSC). This source was only available to areas around the periphery and close to the main transport corridors where it was relatively difficult to divert water.

4.4.2 Water used for all Household Activities

More than three-quarter 281(77.2%) were using all water for all household activities

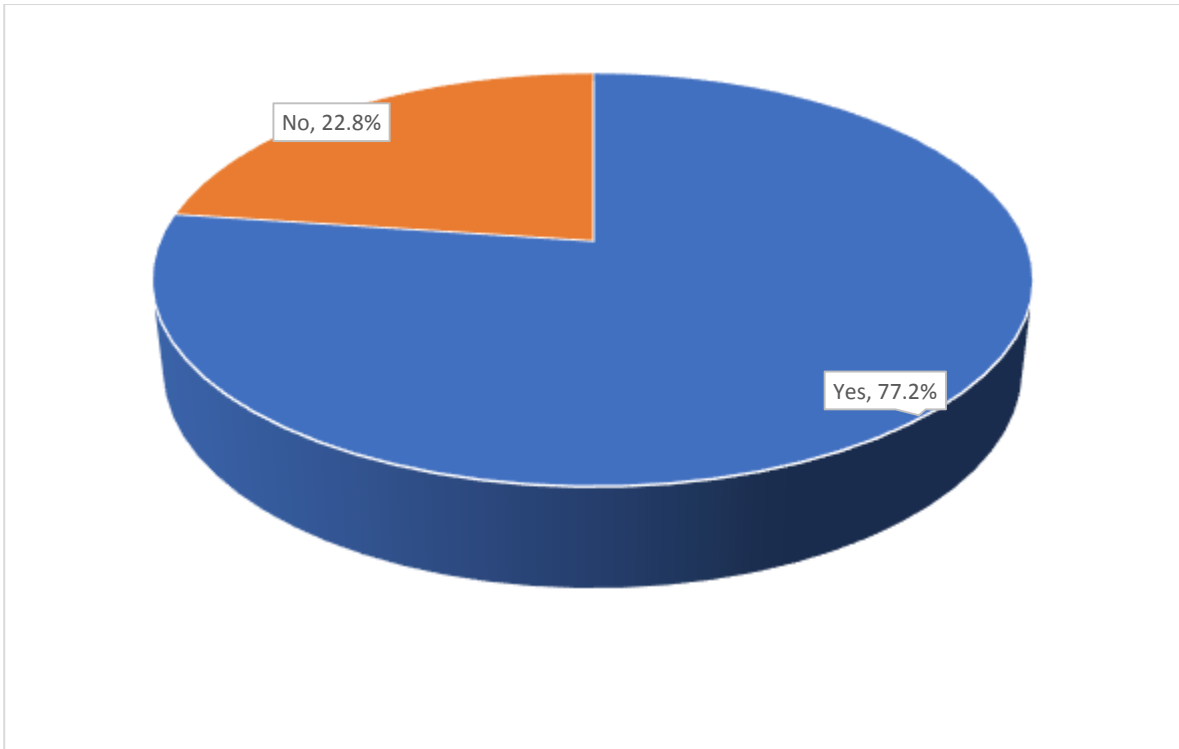


Figure 4. 2: Water used for all Household Activities

4.4.3 Water Governance in Kibera

Slightly less than half 147(40.4%) of water sources in Kibera informal settlement are managed by cartels

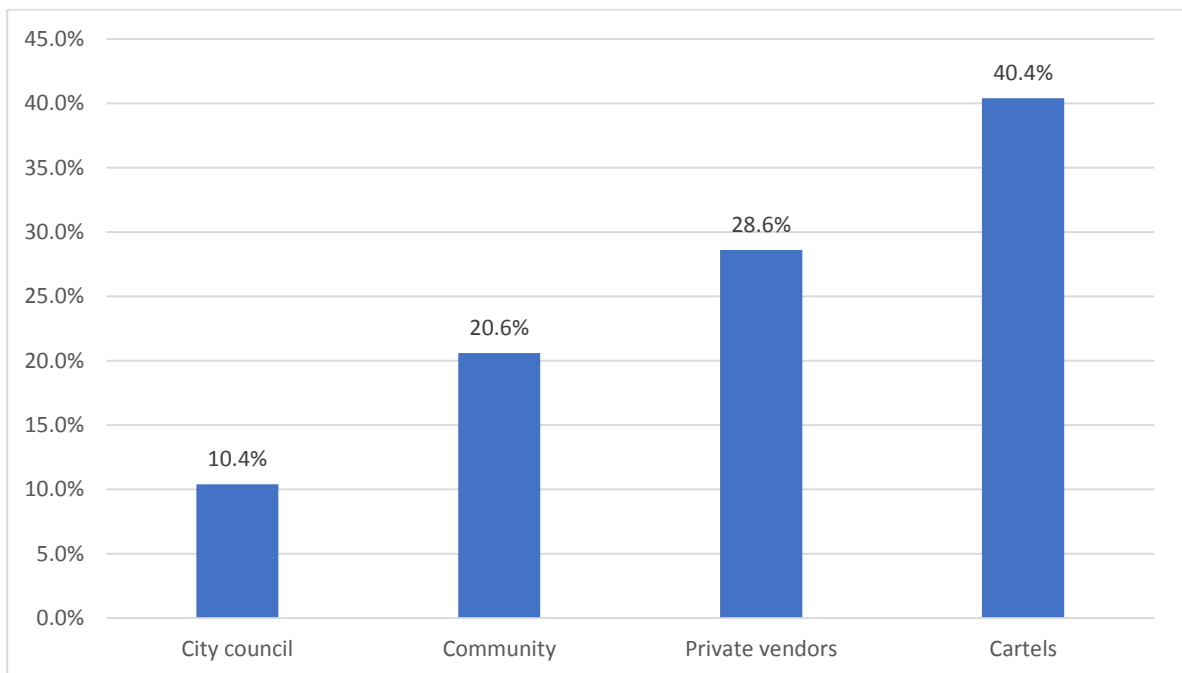


Figure 4. 3: Water Governance in Kibera

This finding agrees with the report compiled by USAID (2012) that cartels manage a lot of water found mostly in Nairobi informal settlements. This is because of the logistics and technicalities involved in laying water pipes.

4.4.4 Availability of Water in Kibera

Slightly less than half 173(47.5%) of respondents receives water between 2-3 days in a week with 173(47.5%) fetching water in the afternoon and more than half 201(55.2%) spending between 31-60 minutes fetching the water from the water sources.

Table 4. 5: Availability of Water in Kibera

Characteristics		Frequency	Percent
Days receive water per week	One day	108	29.7%
	2-3 days	173	47.5%
	4-5 days	51	14.0%
	All days	32	8.8%
Time for fetching water	Morning	108	29.7%
	Afternoon	173	47.5%
	Evening	51	14.0%
	Night	32	8.8%
Duration for fetching water	Less than 15 min	12	3.3%
	15-30 min	119	32.7%
	31-60 min	201	55.2%
	More than 1 hour	32	8.8%

This concurs with a study by German cooperation, (2017) that revealed in Kibera's villages experience frequent water shortages and often it takes about 40 minutes to access water with some areas where water supply is relatively regular with collection times of between 10 and 30 minutes. Majority of the respondents fetch water in the morning and in the afternoon and with a water point density of 400 persons, this time may be more. If this time is quantified economically, the population in the study area could be wasting valuable time that can be utilized in alternative economically viable activities. Time spent on fetching water can be used to do business, clean the house or even attend classes. If time is thought of as an economic resource and even quantified in monetary terms, then inaccessibility to water can be a cause of poverty and other social problems.

According to the respondents, inadequate water can be associated with poverty, food shortage, waste of time and poor health. The most affected are women and children who traditionally are charged with the role of fetching water. It is even worse that at times, school going children have to take part of their school time to fetch water for their families and some don't even attend school as they take responsibilities in their families early in life. The area is at risk of being trapped in poverty due to low investment in human capital. Long distances and time taken by respondents to haul water from various water sources reduce household water consumption and has a negative impact on water demand.

4.4.5 Socio-Demographic Characteristics with Days Receiving Water

Socio-demographic characteristics and their association with days the respondents receive water were investigated. The demographic factors were gender, age, education level, marital status, occupation and monthly income. The findings of this study showed no significant associations between age ($p=0.773$), marital status ($p=0.931$), level of education ($p=0.768$), duration living in Kibera informal settlement ($p=0.546$) and

occupation ($p=0.572$) with days receiving the water per week. However, monthly income ($p=0.026$) determined the days the respondents would receive water per week.

Table 4. 1: Socio-Demographic Characteristics with Days Receiving Water

Characteristics		Days receiving water		Statistic
		≤ 3 days	> 3 days	
Age group	Less than 25 years	40(70.2%)	17(29.8%)	$\chi^2=2.014$ (4) $p=0.773$
	25-29 years	101(78.3%)	28(21.7%)	
	30-34 years	84(79.2%)	22(20.8%)	
	35-39 years	26(76.5%)	8(23.5%)	
	40 years and above	30(78.9%)	8(21.1%)	
Occupation	Student	17(73.9%)	6(26.1%)	$\chi^2=2.001$ (3) $p=0.572$
	Self-employed	56(75.7%)	18(24.3%)	
	Unemployed	168(79.6%)	43(20.4%)	
	Employed	40(71.4%)	16(28.6%)	
Duration at study area	Less than 1 year	54(78.3%)	15(21.7%)	$\chi^2=3.073$ (4) $p=0.546$
	1-3 years	39(79.6%)	10(20.4%)	
	4-6 years	31(67.4%)	15(32.6%)	
	7-9 years	46(76.7%)	14(23.3%)	
	10 years and above	111(79.3%)	29(20.7%)	
Monthly income	Less than Ksh 5000	121 (75.2%)	40 (24.8%)	$\chi^2=10.989$ (4) $p=0.027$
	Ksh 5000-10000	74 (77.1%)	22 (22.9%)	
	Ksh 11000-20000	36 (80.0%)	9 (20.0%)	
	Ksh 21000-30000	29 (80.6%)	7 (19.4%)	
	More than Ksh 30000	21 (80.8%)	5 (19.2%)	
Education	Primary and below	195(76.8%)	59(23.2%)	$\chi^2=0.087$ (1) $p=0.768$
	Secondary and above	86(78.2%)	24(21.8%)	
Marital status	Single	161(77.0%)	48(23.0%)	$\chi^2=0.008$ (1) $p=0.931$
	Married	120(77.4%)	35(22.6%)	

Respondents monthly income influenced the number of days they receive water, water in the informal settlement is expensive and individuals with low income tend to spend less. The demand of many consumer goods, such as water, tends to increase proportionally with the income of households, once the water bill represents a very small portion of the family budget (Hoffmann et al., 2016). Higher levels of living standards imply a higher

quantity of water consuming appliances and the presence of highwater demanding external uses (Cole, 2014; Domene et al., 2015).

4.4.6 Socio-Demographic Characteristics with Time Spent Fetching Water

Assessment of factors influencing time spent fetching water indicates that respondents younger than 40 years spent a lot of time than their counterpart, similarly, most employed residents spent less time in water sources as well as those earning more than Ksh 30000 although it was not significantly associated at $p=0.551$, $p=0.092$ and $p=0.221$ respectively.

Table 4. 2: Socio-Demographic Characteristics with Time Spent Fetching Water

Characteristics		≤ 30 minutes	> 30 minutes	Statistic
Age group	Less than 25 years	24(42.1%)	33(57.9%)	$\chi^2=3.043$ (4) $p=0.551$
	25-29 years	42(32.6%)	87(67.4%)	
	30-34 years	36(34.0%)	70(66.0%)	
	35-39 years	12(35.3%)	22(64.7%)	
	40 years and above	17(44.7%)	21(55.3%)	
Occupation	Student	9(39.1%)	14(60.9%)	$\chi^2=6.448$ (3) $p=0.092$
	Self-employed	22(29.7%)	52(70.3%)	
	Unemployed	72(34.1%)	139(65.9%)	
	Employed	28(50.0%)	28(50.0%)	
Duration at study area	Less than 1 year	29(42.0%)	40(58.0%)	$\chi^2=2.236$ (4) $p=0.692$
	1-3 years	17(34.7%)	32(65.3%)	
	4-6 years	18(39.1%)	28(60.9%)	
	7-9 years	22(36.7%)	38(63.3%)	
	10 years and above	45(32.1%)	95(67.9%)	
Monthly income	Less than Ksh 5000	53(32.9%)	108(67.1%)	$\chi^2=5.721$ (4) $p=0.221$
	Ksh 5000-10000	36(37.5%)	60(62.5%)	
	Ksh 11000-20000	18(40.0%)	27(60.0%)	
	Ksh 21000-30000	10(27.8%)	26(72.2%)	
	More than Ksh 30000	14(53.8%)	12(46.2%)	
Education	Primary and below	88(34.6%)	166(65.4%)	$\chi^2=0.658$ (1) $p=0.417$
	Secondary and above	43(39.1%)	67(60.9%)	
Marital status	Single	68(32.5%)	141(67.5%)	$\chi^2=2.540$ (1) $p=0.111$
	Married	63(40.6%)	92(59.4%)	

Younger respondents take shorter time to fetch water for they have the energy to rush to and from the water sources. Willis et al. (2011) registered that as income increases, water consumption increases too. In the same study it is stated that lower sociodemographic profiles use more water. Therefore, it is important to know the real magnitude of the effect of income on water consumption (Arbués et al., 2003; Chicoine and Ramamurthy, 1986).

4.4.7 Water Accessibility in Relation to its Availability in Kibera Informal settlement

The results indicate that the chi-squared test statistic is 38.322 with an associated p of 0.029. In this case, since $p < 0.05$, therefore the null hypothesis is failed to be accepted that there is no relationship between water accessibility and the availability of a water supply per week option in Kibera informal settlement and the alternative hypothesis is accepted.

Table 4. 3: Water Accessibility in Relation to its Availability in Kibera Informal settlement

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	38.322	4	0.029
Likelihood Ratio	39.999	4	0.028
Linear-by-Linear Association	10.517	1	0.021
N of Valid Cases	364		

4.4.8 Payment of Water used in Household

More than three-quarter of respondents 284(78.0%) pay for the water in Kibera informal settlement with 250(88.0%) paying Ksh 5 per 20 litres jerrican as indicated in table 4.9.

Table 4. 4: Payment of Water used in Household

Characteristics		Frequency	Percent
Pay for water	Yes	284	78.0%
	No	80	22.0%
Cost per 20 lt	Ksh 2	8	2.8%
	Ksh 3	26	9.2%
	Ksh 5	250	88.0%

4.5 Quantity of Water used in Kibera Informal settlement

4.5.1 Water Used in Household

During washing of clothes 217(59.6%) of household consume 80 litres of water spending between Ksh 8-20 and 95(26.1%) consume 100 litres spending between Ksh 10-25. On daily services, almost three quarter 272(74.7%) of respondents consume 60 litres spending between Ksh 6-15.

Table 4. 5: Quantity of Water Used in Household

Characteristics		Frequency	Percent
Water used in washing clothes	40 litres	10	2.7%
	60 litres	42	11.5%
	80 litres	217	59.6%
	100 litres	95	26.1%
Water used per day	40 litres	51	14.0%
	60 litres	272	74.7%
	80 litres	31	8.5%
	100 litres	10	2.7%

From the statistics on average water use, it was also possible to compute the average water used in litres per capita per day in Kibera informal settlement. This was then compared to the average minimum for basic health protection of less than 20 liters per capita per day, of which 7.5 litres is required for consumption as recommended by the

World Health Organization. These levels of access can also be interpreted in terms of household water security as stated by Howard and Bartram, (2013).

The average water use of 20.7 litres per capita per day in Kibera informal settlement barely meets the service level description of basic access. The collected water quantity is classified as low where other domestic chores such as laundry and bathing may occur at water sources with additional volumes of water. Similarly, the quality of water in this category cannot be assured. It is also important to note that these figures are indicative and do not consider the age, gender or occupation of persons in a household. Different categories of persons have varying water demands.

4.5.2 Household Income and Cost of Water

On average, respondents earning less than Ksh 5000 spend Ksh 270 per month on water and Ksh 490 for respondents earning between Ksh 21000-30000

Table 4. 6: Household Income and Cost of Water

	Mean income	Mean litres of water used per day	Mean cost of water per day (Ksh)	Mean cost of water per month (Ksh)
Less than Ksh 5000	3000	40 lts	9	270
Ksh 5000-10000	7500	60 lts	10	300
Ksh 11000-20000	15500	80 lts	12	460
Ksh 21000-30000	25500	80 lts	13	490
More than Ksh 30000	30000	80 lts	13	490

The cost of water is a major factor in the determination domestic activities to be undertaken. This might also take up a significant proportion of the household income. Since this is a daily expense and not a monthly expenditure, it constantly triggers the

findings by World Bank, (2014) revealed that 55% of the slum dwellers in Nairobi paid between 1 and 5 shillings per unit of a 20-litre jerry can. This was the average range charged per unit. 31% paid between 5 and 10 shillings per unit while a further 8% paid between 11 and 15 shillings per unit, 4% paid between 16 and 20 shillings and 2% paid more than 20 shillings per unit. Further insight from German cooperation, (2017) showed that the cost of water depended on the source of water and the prevailing weather season. Borehole water was relatively cheaper costing about 2 shillings per 20 litre unit than treated water from the water kiosks. Water supplied by vendors to households was also charged at a higher cost (between 10 to 20 shillings) than water individually fetched by households from the same water kiosk (normally between 3 to 5 shillings). Further inquiry also revealed that some water kiosks only sold water to vendors who would in turn sell the water to households at an exorbitant fee. These are mainly what households referred to as cartels. In the event of water scarcity, or dry weather periods, water prices escalated arbitrarily and water vendors and cartels cashed in on the households' misery.

4.5.3 Socio-Demographic Characteristics with Payment of Water used in Household
Majority of female 151(81.2%), students 19(82.6%) and between the age of 25-29 years 105(81.4%) paid for the water. However, no variable investigated was significantly associated with payment of water as shown in table 4.12.

Table 4. 7: Socio-Demographic Characteristics with Payment of Water used in Household

Characteristics		Pay for water				Statistic
		Yes		No		
Gender	Male	133	74.7%	45	25.3%	$\chi^2=2.216$ (1) p=0.137
	Female	151	81.2%	35	18.8%	
Occupation	Student	19	82.6%	4	17.4%	$\chi^2=3.418$ (3) p=0.332
	Self-employed	61	82.4%	13	17.6%	
	Unemployed	165	78.2%	46	21.8%	
	Employed	39	69.6%	17	30.4%	
Duration at study area	Less than 1 year	53	76.8%	16	23.2%	$\chi^2=3.242$ (4) p=0.518
	1-3 years	37	75.5%	12	24.5%	
	4-6 years	32	69.6%	14	30.4%	
	7-9 years	48	80.0%	12	20.0%	
	10 years and above	114	81.4%	26	18.6%	
Family Member in HH	Alone	36	78.3%	10	21.7%	$\chi^2=2.735$ (2) p=0.255
	2-5 members	134	81.7%	30	18.3%	
	More than 5 members	114	74.0%	40	26.0%	
Age group	Less than 25 years	40	70.2%	17	29.8%	$\chi^2=5.582$ (4) p=0.233
	25-29 years	105	81.4%	24	18.6%	
	30-34 years	86	81.1%	20	18.9%	
	35-39 years	27	79.4%	7	20.6%	
	40 years and above	26	68.4%	12	31.6%	
Education	Primary and below	199	78.3%	55	21.7%	$\chi^2=0.052$ (1) p=0.820
	Secondary and above	85	77.3%	25	22.7%	
Marital status	Single	164	78.5%	45	21.5%	$\chi^2=0.057$ (1) p=0.811
	Married	120	77.4%	35	22.6%	

4.5.4 Water Affordability in Relation to its Availability in Kibera Informal settlement

The chi-squared test statistic is 16.215 with an associated p of 0.043. In this case, since associated p is <0.05 (table 4.13), the null hypothesis is not accepted and a conclusion is made that cost of water contributes towards accessibility of a water supply option in Kibera informal settlement. Thus, there is a statistically significant relationship between cost of water and accessibility of a water supply option in Kibera informal settlement.

Table 4. 8: Water Affordability in Relation to its Availability in Kibera Informal settlement

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	16.215	9	0.043
Likelihood Ratio	13.690	9	0.134
Linear-by-Linear Association	0.259	1	0.611
N of Valid Cases	364		

4.6 Perception of Water Quality Supplied in Kibera

4.6.1 Perception of Water Supply Services

Most of respondents 134(36.8%) perceived the water supply services on service offered, water quality, waiting time, supplier attitude as fair, only 21(5.8%) perceived it as very poor.

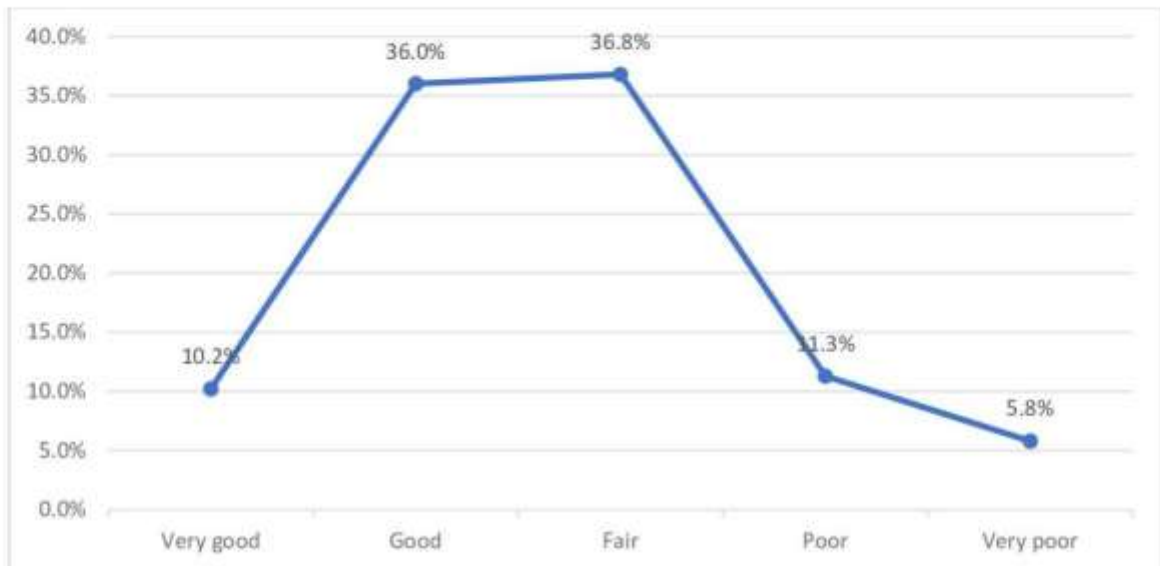


Figure 4. 1: Perception of Water Supply Services

4.6.2 Perception of Water Purity

Most of respondents 145(39.9%) said the water purity is usually pure and almost equally 125(34.3%) said its impure while 94(25.8%) said its sometimes pure or impure as shown in figure 4.5.

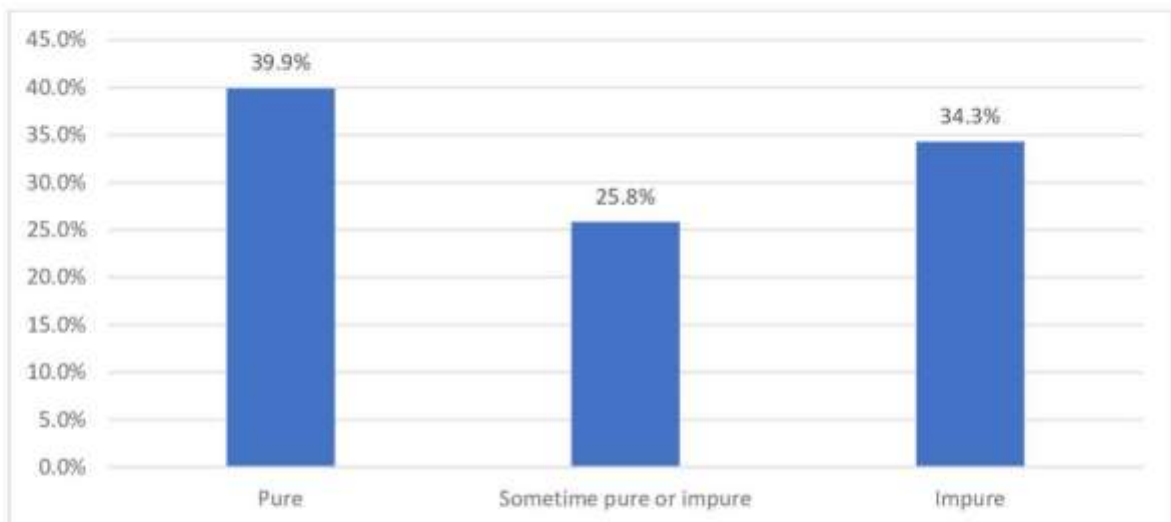


Figure 4. 2: Perception of Water Purity

4.6.3 Perception on Taste of Water

Majority of respondents 147(40.4%) perceived taste of water was fair and 19(5.2%) said were very poor as shown in figure 4.6.

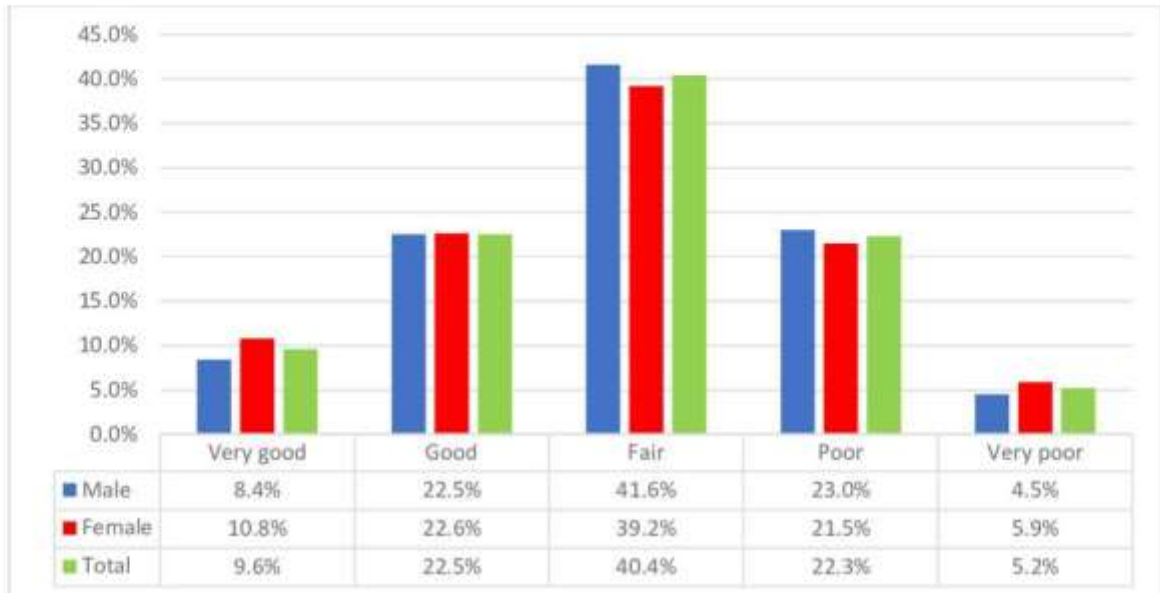


Figure 4. 3: Perception on Taste of Water

4.6.4 Perception of Quality Water in Relation to Availability of Water

Table 4.15 shows that the chi-squared test statistic is 45.391 with an associated p of 0.023. In this case, since associated p is <0.05 , therefore the null hypothesis is not accepted and a conclusion is made that quality of water is related to the availability of a water supply option in Kibera informal settlement. Therefore, there is a statistically significant relationship between quality of water and the availability of water supply in Kibera informal settlement.

Table 4. 9: Perception of Quality Water in Relation to Availability of Water

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	45.391	39	0.023
Likelihood Ratio	49.867	39	0.014
Linear-by-Linear Association	0.023	1	0.879
N of Valid Cases	364		

CHAPTER FIVE: SUMMARY, CONCLUSIONS, AND RECOMMENDATION

5.1 Introduction

This chapter presents summary of findings, conclusion and recommendations of the study in line with the objectives.

5.2 Summary

This study was conducted for the purpose of identifying challenges related to availability of water among residents of Kibera slums, in Nairobi City County. The questionnaire served as the instrument for collecting data and Microsoft excel program and SPSS was used to analyse data. Seven sub-areas in each slum were selected and heads of households were sampled and interviewed.

The proportion of female (51.1%) was higher than that of men (48.9%). The average age of the respondents was 30 years in Kibera slum. Kibera slum had an average of 3.5 members per households. More than half of the respondents had finished primary education and around 27% of them had finished secondary education. Nearly 59% of the respondents were unemployed and 15% were employed while 6% of them were students. This meant that most of the slum residents had no regular monthly income. Almost 45% of respondents had income below Ksh 5,000 which was lower than Kenya's minimum wage of Ksh 9,280 per month. Low income made it difficult for the respondents to access basic services such as water, sanitation, housing, education and electricity.

5.2.1 Water Accessibility in Kibera Slums

Respondents relied on private vendors and kiosks as the main water supply. In regard to physical accessibility, most respondents took more than 30 minutes to water supply points

where they were located and back to respondents' houses because of long queuing time for fetching water. In the requirements by international and national levels, water source should be located less than 1 km and it should take 30 minutes per day to collect water. The slums studied still suffered from a long time taken to collect water every day.

Respondents paid water charges ranging from Ksh 2 to 5 for a 20 liter jerrican. Because of high price of water, respondents from Kibera slums spent more money per month on water which averaged Ksh 400. International guidelines suggested that no more than 5% of income should be paid for water per month. However, over a quarter of respondents spent over 5% of their income on water.

Kenya Water Services Regulatory Board approved new flat rate water tariff from 2015 as Ksh 204 for less than 6 cubic meters. However, the respondents were paying more than three times the new water tariff because they had to buy water from water sellers. Consequently, the fundamental reason of high-water charge in slums was lack of water pipe connection and maintenance by NCWSC. Kiosks provided better water service to the residents with short physical distance, high hygiene conditions, low water cost, few price fluctuations and high satisfactions of water supply rather than water service by private vendors.

5.2.2 Perception of Water Quality supplied in Kibera Slums

About 60% of the respondents expressed their dissatisfaction of the current water supply system including entire service, water quality, waiting time and seller's attitude etc. In terms of water consumption, 54% of the respondents were dissatisfied with it. Respondents in Kibera slums felt that there was long time from their houses to water points. The reason was

the different location of the main water sources in Kibera slums. The main water source in Kibera slum was shared community tap which were located in plots and just next to neighbours while the main water source in Kibera slum was kiosks which were located outside plots. Respondents in Kibera slum had to travel more to collect water. Although community shared tap was located in plots but they controlled only one tap while kiosks had at least two or three taps. This made Kibera residents to take half of queuing time.

According to the water purity, 60% of the respondents in Kibera slum who used kiosks as the main water source dissatisfied with the water purity. On the other hand, 67% of the respondents in Kibera who used handcart as the main water source were dissatisfied with water purity. The reason for these differences was that kiosks were built on permanent structures and managed by communities to keep high hygiene conditions while private vendors rarely managed their water source well.

5.2.3 Water Quantity Used in Kibera Slums

From the findings, it was also established that the quantity of water accessible to the residents in Kibera slum area was determined by the cost of water. The increase in cost of water prohibited availability of more quantity of water as to purchase a large quantity required the respondents to pay a higher cost. This depicts that the cost of water influenced the accessibility of water supply as it determined the quantity of water available for the area residents. They spent around 3 of jerricans of 20 litres for their households. Consumption of water was highly depended on household size and type of water supply. Whereas some respondents spent an average of 24 litres of water per day per person, half of them (50%) spent below 20 litres per day per person. Private vendors' price fluctuated on average 10 times per year while those of kiosks about 3 times per year. During the water scarcity periods, respondents paid nearly double the usual price for a 20 litter jerrican.

Whereas the international guidelines required 20 litres per day per person as the minimum quantity of water and the Kenya government established strategic frameworks for 80% access of households to sustainable safe water, the respondents in this study were not accessing sufficient amount of daily water for their daily consumption

5.3 Conclusions

The households' profiles in the study areas showed typical urban slum forms like sharing one or two rooms with iron sheets and timber with their whole families, irregular employment or self-employment and low-income level.

Respondents in Kibera slums rarely had piped water in their houses and most of them used water services from private vendors and kiosks. While a few of the respondents in slums spent water average of 24 litres per day per person, over half consumed below 20 litres. They took an average 40 minutes to collect water every day. Around one third of the respondents used over 5% of their income for water and they paid three- or seven-times higher cost of the flat rate.

Water accessibility in Kibera slums met neither international guidelines nor national policies at all. Therefore, current water accessibilities in Kibera slums do not meet the minimum requirements of water supply service which human beings should be provided as a basic right for their better quality of life. Although satisfaction with water service was depended on water supply system (private vendors and kiosks), about 60% of the respondents expressed their dissatisfaction with the current water supply system.

Kiosks which were the main water supply in Kibera slum showed less price fluctuation at an average of 3 times per a year than private vendors. Moreover, kiosks provided better water service to the residents within short physical distance, high hygiene conditions, low

water cost, and high satisfactions of the respondents with water supply rather than water service by private vendors.

etc. Without improving housing and electricity, providing indoor water tap is not practicable.

2. Improvement of water supply service in low-income communities should be a priority for most government. Because water is a basic need for human beings' survival and human right to receive proper service, there is a need for review and reform of relevant policies and strategies to focus attention on the needs of low-income communities and to create an enabling environment for service delivery. The multi-sectoral nature of the problem requires a collaborative approach that involves key stakeholders in identifying constraints and in developing a framework for action.
3. The Kenyan government should make decentralized development plan according to rural area, urban area, county, city, rich as distinct from poor counties. Development at national level does not currently cover poor areas. Government should seek out and support each local government and institutions that can help promote water policies and programs in the counties. Not only long-term development plan like Vision 2030 for national level but also short-term development plan like biennial improvement plans for poor areas (slums) with practical action plan should be set. For example, build more (5%) kiosks compared to the previous year in poor areas to increase hygiene conditions, continuity and management and to reduce travel distance, price fluctuation and spending time for water. County governments should consider reducing water price to Ksh 1 per a 20 litre jerrican or less to the poor areas

occupied by a high proportion of lower income earners or supporting community groups to manage the kiosks.

4. Communities based participation should be emphasized to increase water accessibility in slums. This survey showed that kiosks water service managed by community groups provided more affordable and stable water cost, less time consuming to collect water and higher hygiene conditions rather than private water vendors. Community groups can build responsibility to manage water supply systems and provide better water service to the residents. Moreover, they can prevent illegal private water connections which affect water quality and quantity supply to the majority. Managing water service by community groups can also reduce the rate of water payment to NCWSC and lead to better water service provided to them.

5.5 Recommendation for Future Study

This study has encountered other areas which would require further research. These are;

1. Challenges facing the successful implementation of water projects in slum areas
2. It would be of interest to future researchers to establish the implications of water projects on the livelihood of slum dwellers in other slums of the country and of the world
3. As time change so does the perception of the people, so a couple of years down the line, another survey can be done in the same settlement to note if any changes occurred.

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APPENDICES

Appendix I: Consent Form **Title: CHALLENGES RELATED TO AVAILABILITY OF WATER IN KIBERA SLUM NAIROBI CITY COUNTY**

My name is Irene Njeru, I am a postgraduate student at University of Nairobi pursuing a Master in Environment Planning and Management. I am carrying out a research assess challenges related to availability of water in Kibera slums.

Purpose of the study

The purpose of the study is to assess affordability, examine accessibility, assess perception of residents on water quality and identify quantity of water at Kibera Slums. During this study you will be asked to fill a semi structured questionnaire which will take approximately 30 minutes of your time.

Benefits

There are no direct benefits or reward but the results obtained will help in identifying the gaps so that measures to reduce the unmet needs can be undertaken.

Risks and discomforts

I don't foresee any potential risk and discomforts from your participation in the research.

Compensation

There shall be no compensation for taking part in the study.

Voluntary participation

Your participation in the study is voluntary and you may choose to stop participating. Your decision will not be influenced by anyone and it will be respected.

Confidentiality

Confidentiality of participants will be maintained during data collection process and after the study. To ensure anonymity participant will not write their names anywhere in the questionnaire instead codes will be used.

Incase you wish to contact the researcher for any inquiries about the study, feel free to do so through the following contacts;

Researcher;

Mary Irene Njeru; telephone number 07..... Email

.....

Supervisor

1. Dr.;Tel No. 07.....

2. Dr.....: Tel No.07.....

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Legal Rights and signatures;

I consent to participate in the above-mentioned study conducted by Irene Njeru. I have understood everything about this project and wish to participate voluntarily in the Study

Signature of interviewee.....Date.....

Signature of researcher.....Date.....

Appendix ii: Questionnaire

**Title: CHALLENGES RELATED TO AVAILABILITY OF WATER IN KIBERA
SLUM NAIROBI CITY COUNTY**

Study ID: **Date:**/...../.....

Instructions: *Do not write your name or any other personal data on the questionnaire.*

Please follow instructions while answering questions in each area.

The information given here will remain confidential.

Part i: SOCIO-DEMOGRAPHIC CHARACTERISTICS

1.	How old are you? (In completed years)	[]
2.	What is your gender?	1. Male 2. Female
3.	What is your current marital status?	1. Single 2. Married 3. Separated 4. Divorced 5. Widow
4.	What is your educational level?	1. No formal education 2. Primary 3. Secondary 4. College level 5. University level
5.	What is your current occupation?	1. Student 2. House wife 3. Employed 4. Self-employed 5. Unemployed
6.	If married, what is your spouse occupation?	1. Student 2. House wife 3. Employed 4. Self-employed 5. Unemployed
7.	How long have you been living in this area?	.....
8.	How many family members do you have?	.....
9.	What is your monthly house hold income	1. <5,000 2. 5,000-10,000 3. 11,000-20,000 4. 21,000-30,000 5. >30,000

10.	How many members of the household have cash income?
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Part ii: Water Accessibility

11.	What is the major source of your household water supply?	1. Indoor tap 2. Shared tap 3. Kiosk 4. Handcart 5. Others(specify).....
12.	Do you use the water for all household activities, including drinking?	1. Yes 2. No
13.	Who is directly managing water supply?	1. City council 2. Community 3. Private vendors 4. Cartels 5. Others (specify).....
14.	How many days per week do you receive water?	.....
15.	What time usually are you going to fetch water to the water supply place?	.....
16.	How long does it take time to go water point and return to home? (a 20 litre jerry can, round trip)	1. Less than 15 min 2. 16 to 30 min 3. 31 to 1 hour 4. 1 to 2 hours 5. 2 to 3 hours 6. More than 3 hours (specify:.....)
17.	How long do you wait to fetch water?	..... .....

Part iii: Water affordability

18.	Do you pay for the water?	1. Yes 2. No
19.	If YES, how much per 20lt jerry can?	..... .....
20.	How many times do you fetch water in a day?	.....
21.	Do you experience water price change?	1. Yes 2. No
22.	How often did you experience the water price change?	.....
23.	In a typical week, how often do you clean clothes for members of household?	1. Everyday 2. Once after three days 3. Once a week 4. Others (specify).....

24.	When you clean clothes, how amount of water do you spend?	1. 20 litres 2. 40 litres 3. 60 litres 4. 80 litres 5. Others (specify).....
25.	In a typical day, how much water do you use?	1. 20 litres 2. 40 litres 3. 60 litres 4. 80 litres 5. Others (specify).....

Part iv: Perception of water quality

26.	How would you rate the water supply services? (service, water quality, waiting time, supplier attitude, etc.)	1. Very good 2. Good 3. Fair 4. Poor 5. Very poor
27.	How do you rate water purity?	1. Very good 2. Good 3. Fair 4. Poor 5. Very poor
28.	How do you rate water color?	1. Very good 2. Good 3. Fair 4. Poor 5. Very poor
29.	How do you rate water taste?	1. Very good 2. Good 3. Fair 4. Poor 5. Very poor

Part v: Water Quantity

30.	How much water can you store in your house?	.....
31.	How many 20 liters containers do you fetch in a day?	.....
32.	Is the water sufficient for your daily activities	1. Yes 2. No
33.	How much of water does your household consume each day?	.....

Thank you for your responses and the time you spent.

Appendix iii: Interview Schedule for Water Officers

This research is meant for academic purpose. It will try to find out the challenges faced due to water availability in Kibera slums. Responses to these questions will be treated as confidential.

Section 1: General information

1. Date of the interview.....
2. Name of the station.....
3. Gender:
 - a. Male []
 - b. Female []
4. Level of education:
 - a. Primary []
 - b. Secondary []
 - c. College []
 - d. University []
 - e. No formal education []
5. Age (years):

Section 2: Sources of Water

6. What are the main sources of water in Kibera slums?
7. When did water availability become an alarming issue in Kibera slums? State the year.....
8. What are the policies governing water distribution and management in Kibera slums?
.....

Section 3: Socio-Economic Impacts of Water Supply

9. Comment on the following aspects of water in Kibera slums;

- a. Cost.....
- b. Distance to the source.....
- c. Time spent to acquire water from source by most people.....
- d. Reliability of the water sources.....
- e. Quantity of water from sources.....
- f. The gender commonly responsible for water collection. Please tick
 - i. Women [] ii) Men []

10. Are there reported cases of water related diseases such as?

- a. Diarrhoea Yes [] No []
- b. Dysentery Yes [] No []
- c. Cholera Yes [] No []

11. Have there been reported cases of water related conflicts? Yes [] No []

- a. If yes, which conflicts.....

12.

- a. What could be the possible causes of the conflicts.....

.....

13. What are the adaptation strategies to ensure regular water availability by the stake holders?

14. Are there strategies that have been put into place to manage the available water to ensure sustainability for the future?

15. Who is responsible for water management of the municipal council water sources?

16. Are there challenges due to the water supply in the area? Yes [] No []

- a. State some of the major
challenges.....

b. How should the stakeholders deal with the water shortage challenges?

.....

17. In your own opinion, do you think the Nairobi water and Sewerage Company has a role to play in solving the challenges? Yes No

a. If yes, what do you suggest the government should do?

.....

18. a) What season is the water availability (supply) so low? State the months.....

19. What could be the cause of the low levels in the stated months?

.....

20. What are the possible environmental factors contributing to reduced water supply?

.....

21. Could the reduced water supply be due to rapid water drawal leading to a decline in water availability?

22. Could the reduced water supply be due to the following?

a. Leakages in distribution network? Yes No

b. If yes, could be the causes of the leakages be due to?

i. Damages of pipes caused during widening and improvement of roads?

ii. Yes No

iii. Corroded pipes? Yes No

iv. Use of poor quality pipes in connections? Yes No

23. Does the governance of water affect the water supply in Kibera slums?

a. Yes No

b. If yes, no, state how.....

24. Comment on the issue of water supply in Kibera slums

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Thank you