

UNIVERSITY OF NAIROBI

DEPARTMENT OF SOCIOLOGY AND SOCIAL WORK

**EXPLORING COMMUNITY PERCEPTIONS TOWARDS INNOVATIVE
WATER TECHNOLOGIES IN LOW INCOME AREAS IN NAIROBI**

PRISCILLA NJOKI MWAURA

C/50 80772/2012

**A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF
ARTS IN SOCIOLOGY (RURAL SOCIOLOGY AND COMMUNITY
DEVELOPMENT) OF THE UNIVERSITY OF NAIROBI**

DECEMBER, 2017

DECLARATION

This MA project is my original work and has not been submitted in any other university.

Signature.....

Date.....

Priscillah Njoki Mwaura

This project has been submitted for examination with my approval as the supervisor:

Signature.....

Date.....

Prof. Charles Nzioka

Supervisor

.

DEDICATION

This work is dedicated to my Dad Peter Mwaura, for never giving up on me.

ACKNOWLEDGEMENTS

My foremost gratitude is to Almighty God for giving me the ability and strength to study.

My heartfelt gratitude to my parents, Mr. and Mrs. Mwaura, who provided continuous support throughout my education and to my sisters Jerioth, Christine and Stella for their continuous encouragement, moral and spiritual support.

My husband Peter Waiganjo for urging me to continue even when I almost gave up and being my No.1 supporter.

Special thanks to my supervisor at the University of Nairobi, Professor Charles Nzioka for believing in me and being very patient. His mentorship, guidance and support made it possible for me to successfully accomplish this project.

I am forever grateful.

TABLE OF CONTENTS

DECLARATION	ii
DEDICATION	iii
ACKNOWLEDGEMENTS.....	iv
LIST OF FIGURES	viii
LIST OF MAPS	x
ABSTRACT.....	xiii
CHAPTER ONE: INTRODUCTION.....	1
1.1 Background of the Study.....	1
1.2 Innovative Technologies	3
1.3 Statement of the Problem	4
1.4 Objectives of the Study	6
1.4.1 Research Questions.....	6
1.4.2 Specific Objectives.....	6
1.5 Significance of the Study	6
CHAPTER TWO: LITERATURE REVIEW AND THEORETICAL FRAMEWORK.....	9
2.1 Introduction	9
2.2 Sources of Water and Water Quality.....	10
2.3 Types of Technology used in Provision of Affordable and Reliable Water Supply	11
2.4 Effect of Technology in Provision of Affordable and Reliable Water Supply	12
2.5 Economic Impacts of Technology in Provision of Affordable and Reliable Water Supply	17
2.6 Challenges of using Technology for Provision of Affordable and Reliable Water Supply	20
2.7 Theoretical Framework	22
2.7.1 Diffusion of Innovation Theory.....	22
2.7.2 Technology Acceptance Model (TAM)	25
2.7.3 Theory of Planned Behavior.....	26
2.8 Conceptual Framework	29

CHAPTER THREE: RESEARCH METHODOLOGY	31
3.1 Introduction	31
3.2 Study Site Description.....	31
3.3 Nairobi Water and Sewerage Company	33
3.4 Research design.....	34
3.5 Data Collection.....	35
3.5.1 Survey Method	35
3.5.2 Focus Group Discussions	36
3.5.3 Key Informant Interviews.....	36
3.6 Sample Selection Procedure.....	37
3.6.1 Sample size and Selection Criteria	37
3.6.2 Exclusion Criteria.....	37
3.6.3 Sample Size Calculation.....	37
3.7 Data Analysis	38
3.7.1 Quantitative Data.....	38
3.7.2 Qualitative Data.....	39
3.8 Ethical consideration.....	39
CHAPTER FOUR:DATA ANALYSIS AND PRESENTATION AND INTERPRETATION	41
4.1 Introduction	41
4.2 Response rate.....	41
4.3 Social Demographic Characteristics	41
4.3.1 Residence.....	41
4.3.2 Marital Status.....	42
4.3.3 Level of Education.....	43
4.3.4 Religion	44
4.3.5 Occupation.....	45
4.3.6 Source of income	45
4.3.7 Other Sources of Income	47
4.4 Affordability.....	48
4.3.1 Unregistered PPD Water Users	49

4.3.2 Water Charges	50
4.3.3 Affordability Perception	52
4.3.4 Mode of Payment.....	53
4.3.5 Perception on the New Technology.....	55
4.3.6 Water prices	56
4.3.7 Ownership of Tokens/Cards	59
4.4 Water Accessibility	61
4.4.1 Hindered Use of Water	62
4.4.2 Facilitated Use of Water	63
4.4.3 Loss of Card/Token	64
4.5 Convenience and Ease of Use	66
4.5.1 Convenience	67
4.6 Summary	68
CHAPTER FIVE:SUMMARY, CONCLUSION AND RECOMMENDATIONS...	70
5.1 Introduction	70
5.2 Summary	70
5.3 Conclusions	71
5.4 Recommendations	71
5.5 Areas for further research.....	72
REFERENCES.....	74
ANNEXES	i
ANNEX 1: FOCUS GROUP DISCUSSION TOPIC GUIDE	i
ANNEX II: PARTICIPANTS QUESTIONNAIRE	i
ANNEX III: CONSENT FORM.....	i

LIST OF FIGURES

Figure 1: Respondents Residence	42
Figure 2: Marital Status	42
Figure 3: Level of Education	43
Figure 4: Religion	44
Figure 5: Salary/Wage	45
Figure 6: Source of Income.....	46
Figure 7: Other Sources of Income.....	47
Figure 8: Direct Users of PPDs.....	48
Figure 9: Water Charges Awareness.....	51
Figure 10: Actual Water Charges	51
Figure 11: Is The Water Affordable?.....	52
Figure 12: Mode of Payment	53
Figure 13: How Do You Find The Technology?	55
Figure 14: Convenience of the Technology.....	55
Figure 15: Is The Water Cheap.....	57
Figure 16: Ownership of Tokens/Cards.....	60
Figure 17: Water Technology Rating	62
Figure 18: Water Access Without Cash.....	64
Figure 19: Lost Card Before	64
Figure 20: Amount of Times Card Lost.....	65
Figure 21: Ease of Replacing Prepaid Token Card.....	65
Figure 22: Water Meeting All Domestic Needs	67
Figure 23: Ease of Use of Water Machine.....	67
Figure 24: Convenient to use Card/Token.....	68

LIST OF TABLES

Table 1: Levels of Income	46
Table 2: Other Sources of Income	48
Table 3: Duration for using PPDs/Water ATMs.....	49
Table 4: Reasons for Not Registering.....	50
Table 5: Mode of Payment and Affordability.....	54
Table 6: Why it is not convenient.....	56
Table 7: Crosstab of Main source of income and Cheapness of Water	58
Table 8: Location, availability and accessibility.....	61
Table 9: Hindrances	62
Table 10: Facilitated use of Water	63

LIST OF MAPS

Map 1 : The map of Mathare, Nairobi Kenya (Corburn and Karanja, 2015)32

Map 2: The map of Kahawa Soweto, Nairobi Kenya(Saba, 2005)33

LIST OF ABBREVIATIONS AND ACRONYMS

ATM	Automatic Teller Machines
BAIL	Build America Investment Institute
EPA	Environmental Protection Agency
FGD	Focus Group Discussion
GoK	Government of Kenya
GSM	Global System for Mobile Communication
KES	Kenya Shillings
KOL	Key Opinion Leaders
MDG	Millennium Development Goals
NCWSC	Nairobi City Water and Sewerage Company
NWSS	National Water Services Strategy
O&M	Operation and Maintenance
PEOU	Perceived Ease of Use
PPD	Prepaid Dispenser
PRSP	Poverty Reduction Strategy Paper
PU	Perceived Usefulness
SPSS	Statistical Package for the Social Sciences
SWAP	Sector Wide Approach to Planning
TAM	Technical Assistance Model
TAM	Technology Acceptance Model

TPB	Theory of Planned Behaviour
USDA	United States Department of Agriculture
VLOM	Village level Operation and Maintenance
WASH	Water Sanitation and Hygiene
WEDC	Water, Engineering and Development Centre ()
WHO	World Health Organization
WUE	Water Use Efficiency

ABSTRACT

Innovative innovation has a solid part to play in the water industry going forward. To better comprehend the execution of their advantages, water utilities/associations are increasingly implementing technologies all through their operations especially when it comes to supply.

Water provision in the informal settlements has been a huge task for most utilities in Africa, like in numerous different ghettos and shanty towns around the globe, water in this settlements is rare, expensive, uncertain, and contaminated and occupants pay more for water than wealthier Kenyans in tapped neighborhoods of Nairobi.

Quantitative data were obtained from a randomly selected sample of 230 residents who used the prepaid water solutions prior to this study. The areas of focus were on their sources of information, attitudes towards family planning, participation in decision making and socio-cultural factors that influenced their decisions to use specific male methods as their preferred choice. Additional qualitative data was further obtained through focus group discussions and key informant interviews with the residents, local administrators and key project staff.

The study found that generally 98% of the residents believed that the prepaid solutions were affordable and had slowly adopted and embraced the new technologies and were happy now that they were assured of water that was easily accessible, regular and affordable. From the findings 92% of the residents interviewed and were unemployed agreed that prepaid water solution were a cheaper solution as compared to getting water from other vendors.

The study concluded that there is still a huge gap in service provision within the low income areas in Nairobi. NCWSC, County Government and NGO involved in WASH projects should come together and address the main issues that are faced by the residents in regards to water provision such as water cartels,(determine pricing)water quality and irregular supply. To enhance this there is need to (i) develop policies management of water supply and implementation of water technologies (ii) involve communities in decision making on matters that affect them directly (iii) improve on water supply and quality of water in the informal settlements (iv) community engagement and outreach programs should be at the core of any project to ensure sustainability and continuity.

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

Water is at the focal point of financial and social improvement; it is crucial to maintain wellbeing, develop sustenance, deal with the earth, and make occupations. However in the year 2007, 1.2 billion individuals did not approach safe water supply (IRC Report, 2007). Regardless of its significance, more than 783 million individuals on the planet are still without access to enhanced water sources, and much more are without access to reliably safe drinking water (Undp, 2013). Water, sanitation and hygiene related diseases such as diarrhea killed two million people and caused four billion episodes of illness worldwide in 2011 (Who and Unicef, 2012). In today's world of 6 billion people (World Bank Report, 2007), providing this water and sanitation facilities is already a serious challenge, straining management systems and institutions.

In Africa, between 75 million and 250 million individuals in Africa will live in territories of high water worry by 2030, with water shortage in some bone-dry and semi-dry places liable to uproot between 24 million and 700 million individuals (Strobl and Strobl, 2008). Water shortages in Africa, are related to both under-development of potentially available water resources and their uneven distribution. This is coupled up with an unrelenting population growth rate of 3 % per year which is a major factor in on-going water and sanitation problems.

Kenya has experienced tremendous population increases in the last 40 years with an annual population growth last reported at 2.63% in 2010 (Water Resources Management, 2012). In 2009, it was indexed at 2.58% according to a World Bank Report of 2010. The annual population growth rate in Kenya was reported at 2.58% in 2008 (Water Resources Management, 2012). It is important to note that urban growth has been at the rate of five per cent in the last forty years. In 1963, the urban population in Kenya was low at 8%. Currently 34% of the population lives in the urban centres. Projections show that by 2030, 50% of Kenyans will be living in the urban areas (Malenya, Malenya and Omwenga, no date) (Amnesty International, 2009).

The Ministry of Water and Irrigation in Kenya has been implementing the water sector reforms since the enactment of the Water Act 2014 to improve sector efficiency and overall performance but more importantly created new decentralized institutional framework to among others accelerate water service provision. The sector's approved development budget rose seven fold since year 2004-2012 from KES4.2 billion in 2004/2005 FY to KES 30.8 billion in the 2011/2012 FY (Ministry of Water and Irrigation, 2015).

Innovative innovation has a solid part to play in the water industry going forward. To better comprehend the execution of their benefits, water utilities/associations are increasingly implementing examination technologies all through their water supply chains, including system meters and system administration arrangements. By placing system meters at different intervals in the inventory network, including its source and circulation points, utilities can evaluate the execution of individual segments, and address spillages and different issues all the more successfully and effectively, and organize regions to redesign in view of assets accessible. The better water utilities comprehend their systems, the more financially savvy they can be in operating them. Truth be told, another industry contemplate discharged toward the finish of 2012 indicated savvy water systems could spare water utilities up to \$12.5 billion every year around the world. These savings, the report stated, would come about because of "enhanced spillage and weight administration, key prioritization and distribution of capital consumptions, and streamlined water quality monitoring" achieved with continuous information gave by the system.

Driven by require, innovation will continue to happen within the water industry all inclusive. Nearby that, however, comes the requirement for both better industry and client consciousness of the issues and the arrangements accessible. Water look into by Oracle demonstrated that 36 percent (Oracle, 2011) of utilities over the globe are as yet unconscious of the full scope of innovation alternatives open to them. In the meantime, numerous clients are neglectful of the requirement for change, for preservation, for another way to deal with water as a valuable - and waning - asset. It is just when

innovation and training both go to the cutting edge that we will see expansive scale changes begin to happen.

1.2 Innovative Technologies

The capability of innovation to take care of societal water issues is tremendous and unexploited. Water stockpiling, dry spell, flooding, obscure water approaches, and absence of information straightforwardness on access to water are a portion of the water-related issues that subjects confront. Shoppers and water merchants have detected the capability of innovation in solving water issues and have created applications and administrations that can conceivably ease water issues. To curb the problem of water supply in informal settlements the government has come up with new technologies for supply of water in these areas.

To create an affordable and sustainable water service for residents of informal settlements, whilst ensuring reasonable revenue realization, NCWSC needed to take control of distribution and sale of water to customers. The company has adopted and employed continuous management improvement practices, emerging technologies and application of structured third party involvement interventions. The company is currently implementing the prepaid meters in the informal settlements. The prepaid meter is a smart water management device designed for easy public and shared access to clean water. The technology uses a cash-flow management system and the consumers can access safe and affordable water from the dispenser using tokens. The consumers upload or purchase small amounts of credit onto a “token” at the Company. The success of the pre-paid meters is critically hinged on collaboration between various business units within NCWSC, elimination of spaghetti/ illegal connections, adequate distribution system pressures (minimum per dispenser specifications or as determined through tests to ensure economic and consumer convenience in operations (per Section 8 clause 6) and robust community engagement. Operation of the water meters will be based on a contractual agreement between NCWSC and the operator at the community level.

‘WaterATM’ is an easy to understand robotized water dispensing machine installed over filtration plants. It controls utilization of clean drinking water by using a client validation

instrument. It gives mechanical innovations and help in saving clean and separated water wastage which in the end impacts the community wellbeing. Late advances in remote sensors, close by pervasive accessibility of versatile (GSM) organizes in developing nations now make it conceivable to remotely and naturally screen the nature of water being apportioned, in this manner eliminating the human blunder/ fiendishness component from the framework. In an offer to support access to clean water, four water dispensing machines have been installed in Nairobi ghettos that work like money machines – with clients ready to purchase moderate water using keen cards. The machines are worked by neighborhood occupants – youth and ladies bunches – who gain 40% of the benefits from the water deals as an incentive to guarantee they are continued running and the framework isn't vandalized. Already, pipelines were harmed when a few people attempted to take the water. Presently with the new machines and water points, the administration trusts there will be less motivation to harm the channels.

This research study therefore, will be exploring the perceptions of the water consumers in the Nairobi's informal settlements towards innovative technological interventions in providing affordable and reliable water supply.

1.3 Statement of the Problem

Informal settlement occupants constitute between 40 % and 70 % of the populace in all major urban focuses in Kenya (APHRC., 2014)(International, 2009). These settlements are characterized by poor water and sanitation service provision. These informal settlements are characterized by high density and low income settlements that are not included in the city planning for any kind of sewage, drainage or water services. Lack of these services render slums unhygienic living place for the residents.

In Kenya alone, 8.5 million people live in such low income settlements and the population is increasing rapidly at 6% per year. In these congested and resource-constrained urban informal settlements that lack access to sewer or water lines, improvements to the sanitary conditions require more than the current approach of just building toilets. Informal settlement occupants are the most astounding paying purchasers in the city per cubic meter. By and large, poor non-associated family units spend a higher

offer of their month to month income on water¹⁶. In Nairobi, as in most African urban communities, absence of access to present day water administrations is a contributing component to neediness since families spend constrained income on costly water.

The absence of planning, absolute minimum investments and specially appointed coordination, of sterile conditions in Nairobi's informal settlements region lasting wellbeing risk and an attack against human nobility. Sanitation in informal settlements is out and out much more awful and more mind boggling than water supply. While NCWSC and those retailing its water are the essential on-screen characters in the conveyance chain for water supply benefits, this isn't the situation for sanitation, which is principally the domain of individual family units. Waterborne sewerage is the main part of comprehensively defined sanitation that is under the immediate duty of NCWSC. The nominal duties regarding different parts (drainage and strong waste) are shared between families, community gatherings and civil offices.

Despite the broad ranging water sector reform and the commitment to invest in water supply and sanitation, Kenya still faces considerable challenges in reaching the water and sanitation with 15.8 million more people in need of access to water and 16.5 million to sanitation(Maji Data, 2012). Maji Data states that Kenya has more than 1,800 low income areas with a total estimated population of more than 8.5 million. In Nairobi alone around 100 unplanned settlements with a population of 1.75 million exist (around 50% of Nairobi's population) and the number of areas and population are increasing. The Kenyan government is constrained by capacity and funding to improve basic service provision in informal settlements leaving slum residents in Nairobi vulnerable to a host of health and environmental hazards (Analysis and Investments, 2011).

According to Government statistics, around 57% of family units that approach water and utilize water from sources thought about safe. Sustainable access to safe water is evaluated at 60% in urban regions, with a decline to 20% within the informal settlements and 40% in the rustic territories. In Nairobi, 58% of aggregate families, for the most part residing in informal settlements, obtain water from water stands, informal water conveyance administrations, for example, pushcarts and unlawful water associations. In

regard to essential sanitation the Ministry of Water and Irrigation evaluates a national scope of half with sanitation scope assessed at 55% in urban regions (COHRE, 2008).

1.4 Objectives of the Study

The general objectives of this study was to explore the perceptions of the communities towards innovative technology in providing affordable and reliable water supply in Nairobi informal settlements

1.4.1 Research Questions

- i. What are the individual perceptions of water consumers in the informal settlements to introduction of innovative technologies in providing reliable water supply?
- ii. What are perceptions of the water consumers in the informal settlements to low fee-for-service model/approach of providing sustainable and reliable water supply?
- iii. What is the role of the community leaders in introducing accessible and affordable water supply to the communities in the informal settlements in Nairobi?

1.4.2 Specific Objectives

- i. To investigate the perceptions of individual water consumers on the introduction of technology in providing reliable water supply informal settlements.
- ii. To explore the views of water consumers on the model/approach of charging for water supply in the informal settlements
- iii. To investigate the community leaders role of in enhancing the provision of water supply to the communities in the informal settlements in Nairobi.

1.5 Significance of the Study

Improved sanitation and access to safe water promotes improved health in areas where sanitation facilities exist but that community involvement and integration plays a significant role in providing acceptable, affordable and hygienic sanitation in urban

slums. Approximately 80% of all illnesses and 25% of all passings in developing nations are caused by contaminated water and insufficient water supply, sanitation and cleanliness (Gleick, 2015). This circumstance is especially complemented in urban ghettos where get to rates to WASH administrations are normally low. Among the most widely recognized infections are looseness of the bowels, cholera, intestinal sickness, diarrhea, schistosomiasis, dengue fever, typhoid fever, gastroenteritis, hepatitis An and growth. Diarrheal sicknesses represent a genuine danger of lack of healthy sustenance.

Grown-ups who are sick or who need to deal with their youngsters are less beneficial. Furthermore, the wellbeing costs induced by the absence of sufficient water, sanitation and cleanliness practices can expend a vast piece of the poor family's income. The time spent to get water can't be invested into income-generating exercises

While the procedure of urbanization basically decreases the normal time spent by ladies collecting water when contrasted with their rustic partners, the increased danger of contracting water-borne sicknesses as the essential handlers of contaminated water, the genuine test to regenerative wellbeing displayed by an absence of clean water and cleanliness administrations, and the additional obligation of providing consideration to kids and other relatives suffering from disease continue to successfully prohibit numerous ladies and young ladies from instructive open doors.

Because of the absence of satisfactory sanitation offices, many individuals living in urban ghettos are compelled to poop in the open. With a specific end goal to protect their poise, they regularly endeavor to poop in the open under front of haziness. This represents a vital security hazard, especially for ladies and young ladies. This hazard is additionally given if water should be gotten during the night. It is therefore paramount to provide safe and reliable water and sanitation to the communities living in the informal settlements to provide dignity and perpetuate hygiene.

Ailments, high rates of mortality and diminished efficiency induce extensive monetary expenses. It is assessed that Sub-Saharan Africa loses around 5 for each penny of Gross Domestic Product (GDP) because of sick wellbeing as a result of poor water and sanitation – more than the aggregate estimation of help these nations get (Tearfund.,

2008). Studies have demonstrated that investments in sustainable sanitation in developing districts brings an arrival in the scope of US\$5 to US\$46 (depending on the intervention) for each US\$1 invested (Gleick, 2015).

Because of an absence of room, pit latrines are frequently built near groundwater sources, for example, wells, hand pumps or springs. During overwhelming rains, the latrines have a tendency to get overflowed, resulting in water seeping through the dirt, contaminating the groundwater. Furthermore, as the impenetrable and unvegetated ground of ghetto territories has almost no maintenance during overwhelming rains, human and creature squanders are flushed into the stream frameworks polluting urban water supplies, waterways and profitable beach front waters(Mafuta et al., 2011).

The findings of this examination will likewise be valuable to the ghetto inhabitants as it would feature the perspectives and opinions of the recipients of such water advances to additionally comprehend their necessities and get a reasonable point of view of how they see these water supply innovations and the territories they feel can be enhanced to raise their living guidelines. This is an important aspect of community participation in development projects where they are incorporated in the planning and implementation as well as operation of these projects with the aim of giving them a sense of ownership and collective responsibility. The views collected in this study will give much valuable insight to the policy and decision makers even as they identify critical areas that may have been ignored and disseminate funds for these technologies.

CHAPTER TWO: LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

Globally, the test identified with the administration of water supply and circulation exists somewhat because of broad industrialization, increased populace thickness and a high rate of urbanization(Akpor 2011., n.d.). Basic to life in all its decent variety, water is the soul of society and an establishment of human advancement. Water is the key asset of the 21st century. The administration of water assets and supply is basic to the improvement and development of cities(Henry, Yongsheng and Jun, 2006). Sustainable asset utilize and the arrangement of value administrations to a growing urban populace underpins the accomplishment of future urban areas, empowers them to go about as shafts of monetary development, and is at the center of social and financial advancement in a urbanizing world. In the course of the most recent decade, privatization to a more prominent degree has been viewed as one of the essential approaches to infuse capital into the urban water part and to beat a portion of the inefficiencies of metropolitan administration. It has been encouraged after developing nations by international lending offices as a fundamental part of water area change (Mckenzie, 2009).

In Africa between 75 million and 250 million individuals in Africa will live in regions of high water worry by 2030, with water shortage in some parched and semi-dry places prone to uproot between 24 million and 700 million individuals (Strobl and Strobl, 2008).Water shortages in Africa, are related to both under-development of potentially available water resources and their uneven distribution. This is coupled up with an unrelenting population growth rate of 3% per year which is a major factor in on-going water and sanitation problems.

Kenya has experienced tremendous population increases in the last 40 years with an annual population growth last reported at 2.63% in 2010 (World Bank, 2010). In 2009, it was indexed at 2.58% according to a World Bank Report of 2010. The annual population growth rate in Kenya was reported at 2.58% in 2008 (World Bank, 2010).It is important to note that urban growth has been at the rate of five per cent in the last forty years. In

1963, the urban population in Kenya was low at 8%. Currently 34% of the population lives in the urban centres. Projections show that by 2030, 50% of Kenyans will be living in the urban areas (Breslin, 2013)(UN Habitat., 2014).

2.2 Sources of Water and Water Quality

In choice of a wellspring of supply, the different variables to be considered are sufficiency and dependability, quality, cost, lawfulness, and legislative issues. In selecting a wellspring of drinking water, there are various components that must be viewed as (IEA, 2007)(Analysis and Investments, 2011): Quantity, quality, assurance from contamination and attainability. The significant wellsprings of a water supply are surface water and groundwater. Previously, surface sources have included just the usually occurring regular new waters, for example, lakes, waterways, and streams, however with quick populace extension and increased per capita water utilize related with a higher expectation for everyday comforts, thought must be given to desalination and waste-water recovery too (Ezugwu, 2015).

According to the Ministry of Water and Irrigation (2005), the fundamental prerequisites for drinking water are that it ought to be free from pathogenic (malady causing) life forms, containing no aggravates that have an antagonistic intense or long haul impact on human wellbeing, genuinely clear (i.e. low turbidity little shading), not saline (salty), containing no intensifies that reason a hostile taste or smell, not causing consumption or encrustation of the water supply framework and not staining garments washed in it. An overview led on the in Lome city in Togo demonstrated that individuals know about the circumstances and end results of poor water quality (Ahiablame, Engel and Venort, 2012). There is an entrenched relationship between's the scope and nature of drinking water supply administrations, sanitation, wellbeing, and nature of life(Carlos et al., 2002). Experience indicates that water-borne pestilences have a tendency to vanish all the more rapidly in places with great sanitation and where the nature of the drinking water supply is ensured

Sufficiency of supply of water requires that the source be sufficiently vast to take care of the whole water demand. Add up to reliance on a single source, in any case, is as often as

possible bothersome, and at times, enhancement is basic for dependability (Ezugwu, 2015). The capacity of determination criteria for a water supply benefit is to choose when specific territories ought to be furnished with water administrations. The intense outcomes that emerge from absence of water benefits in the urban regions makes the presence of urban populace alone an adequate criteria for providing water supply administrations (Irrigation, 2007).

2.3 Types of Technology used in Provision of Affordable and Reliable Water Supply

Some of the technologies that offer efficiency gains over current practices in the sourcing, treatment and/or transportation of water fall in application areas such as pumping systems and controls; Water Use Efficiency (WUE) and water ATMs. Pumping and controls technologies generally can provide greater total electric energy savings compared to water treatment technologies. This is primarily a result of pumping currently accounting for the majority of total electricity consumption in public water supply and agricultural irrigation. However, the expected future growth in the utilization of marginal quality water sources, such as saline water and wastewater effluent, will require additional electricity consumption for the treatment of water. The availability of efficient desalination technologies, such as reverse osmosis, capacitive deionization and membrane distillation, along with other advanced treatment technologies, will be critical to minimize electricity consumption growth.

The pumping and controls, and water use efficiency technologies also offer the benefit of being complementary to one another. This means that the technologies can operate in concert and that the energy savings for the various technologies are additive. Of course, as one technology reduces the energy consumption baseline the absolute savings potential of subsequent technologies will be reduced. Nonetheless, the combined technical potential for these technologies could reach 30% to 50% of baseline energy consumption.

Water Use Efficiency: A simple means of reducing the energy consumption related to water treatment and transport is to reduce the volume of water supplied by water utilities. Ample water conservation opportunities exist in the form of loss prevention and reducing customer demand. Typical water distribution losses were estimated by the California

Energy Commission to vary between 5% and 30%, with an average of 10% for all water utilities (United Nations Environment and Programme, 2005).

The Kenyan government is installing water vending machines in the slums of Nairobi to address the city's increasingly dire lack of clean water accessibility. In partnership with a Danish water engineering company, they've placed four of the water ATMs, which can be accessed with "smart cards," around the impoverished neighborhood of Mathare. Users store "water credits" on their smart cards, which they can then use to purchase clean water. A simple swipe of the card sends water gushing out of a pipe into whatever container is positioned to collect it. ATMs, however, dispense 20 liters of water for half a Kenyan shilling – which is equivalent to half of an American cent. Access to clean water is a fundamental human right, one which should be furnished for free. These water ATMs provide, at least, a more affordable alternative to the water vendors, who sell the same amount of water for 50 Kenyan shillings, making clean water a luxury for most Kenyans living in the slums.

2.4 Effect of Technology in Provision of Affordable and Reliable Water Supply

Technology and changes in technology may influence the accessibility or supply of water, interest for water and levels of water utilize. Industrialization, for instance, normally increases the interest for water, at any rate initially. Notwithstanding, mechanical improvements that allow clients to streamline on water such advancements as water-efficient indoor plumbing apparatuses, shut conductor water system frameworks like dribble and small scale sprinkler frameworks, and modernized water system administration strategies every now and again result in diminishment in water utilize. Specialized changes that enhance timing and lower expenses of supply can likewise influence water utilize. For instance, the development of impoundment offices grants control and direction of spillover and allows more steady levels of supply. Throughout the most recent century, pumping technology enhancements have made new wellsprings of ground water accessible that already couldn't be misused in light of their profundity. Then again, inability to utilize present day technology may mean lower amounts and higher expenses of accessible supply.

While enhancements in technology have now and then significantly increased the accessibility of water supplies, technology can likewise create undesirable and unanticipated symptoms. Some technology-induced or technology-influenced changes in water supply might be reversible just after some time sizes of thousands of years. For instance, the development of huge dams, misuse of ground water and water system hones (Classification et al., 2002) may modify water quality, territorial hydrology, and water-subordinate biological communities in ways that are either unthinkable or restrictively costly to turn around on any sensible time scale. Thus, an entire evaluation, including contemplations of sustainability (and intergenerational value), of the effects of new and existing water supply technology ought to distinguish particularly the time domains over which the advantages and expenses of the technology are probably going to be borne.

Technological advancement affects the efficiency and performance of all organizations and therefore the impact of technology cannot be overlooked (Imran, 2014)(Kinyanjui and Wanyoike, 2016). Because of the ever-changing market needs, trends and the very dynamic environmental factors, adoption of appropriate technology can give water supply companies a competitive edge(Kinyanjui and Wanyoike, 2016). Technology advancement in communication has broken boundaries turning the world into a global village. It has given new ways of professional and technical personnel operations in organizations of all levels. As a result, water service providers should open up to technology to improve planning, executing and managing projects. They have opportunities to develop highly specialized auto-motives to provide water and sanitation facilities to peri-urban communities in a pay as you use basis and have digesters for efficient disposal.

Aharikundira (2015) in their study on sustainability of water services delivery in urban poor settlements revealed that water supply trends in the past, present and future projections are very necessary for sustainable management. Current technological advancements were identified as key in enhancing water supply operations. Similarly, Lencha (2012) studied rural water supply management and sustainability in Ethiopia, Adama area and concluded that technical know-how and development are important in critical to achieve sustainability within systems. In rural water supply projects,

sustainability is dependent on community proprietorship and administration. The people group take the final choice on essential parts of the planning and usage of water supply plans. Good leadership play crucial roles in community based projects. This requires a firm foundation on trust and good working relationships with all stakeholders. There is need for time, resources and authority to invest in a water supply project. Flexibility is critical in the way project leaders implement project the activities the projects undertake(Aharikundira, 2015.)

Many studies and reports have documented the influence or effect of choice of technology on sustainability of community managed rural water supplies (Bredero, 2003). Sector professionals have used various terms to portray reasonable, basic advancements that could without much of a stretch be adjusted to nearby conditions and maintained by groups; among them-fitting technology, dynamic technology, elective technology, Village level Operation and Maintenance (VLOM) technology, intermediate technology, Village technology, Low - Cost technology, Self-help technology and even technology with a human face(Brikke et al., 2003). Brikke et al (2003) recommended the utilization of "sustainable technology at the community level" and contended that tasks must incorporate determination of fitting technology and integrate Operation and Maintenance (O&M) into venture advancement ideal from the begin(Brikke et al., 2003).

An examinations of the execution of water frameworks in an assortment of nations found that execution was extraordinarily better in groups where family units could settle on informed decisions about the kind of framework and the level of administration they required(Mansuriet al., 2003).Among specialized components recommended to add to sustainability of administrations are technology choice, intricacy of the technology, the specialized limit of the framework to react to the request and give the coveted administration level, the specialized abilities required to work and maintain the framework, the accessibility, availability and the cost of extra parts and the general cost of O&M.

Framework plan and the multifaceted nature of the technology involved will obviously have a bearing on the relative weighting of these variables. For the situation of hand pumps for instance, institutionalization of pump composes, save parts, support to the

private area for nearby repairs and institutional game plans with respect to government in help of community administration were altogether observed as essentially critical factors in the sustainability of ventures in Africa according to late research by Water, Engineering and Development Center (WEDC) Loughborough University (Squires and Squires, 2006) ("Harvey et al.," 2009). Sustainability of offices gave is improved by involving the private segment in the immediate arrangement of administrations to groups and emphasizing sound financial administration and satisfactory cost recuperation by community-based associations. The greater part of the above develop with a legitimate and institutional structure. At national level there must be clear approaches and systems that help sustainability (Brikke et al., 2003). Bolster exercises, for example, specialized help, training, monitoring and setting up viable financing frameworks are on the whole prone to influence viability of O&M.

Settlement example of a community additionally influences the decision of water supply technology and O&M. For example, a hand pump would serve only a limited number of people in a settlement structure where households are located on individual farms. Ground water characteristics also influence choice of technology. For example, the choice between a hand pump based system and a diesel powered system will be influenced by the size and depth of the ground water and demand or population to be served.

According to Muller (2008), where the Free Basic Water Policy (FBWP) has been executed in the rustic zones, the significant determinant of water utilization has been the separation over which it is conveyed from source to home (Muller, 2008). The fundamental level of water supply benefit requires that water source points be found not more than 200 meters from the family unit (DWA, 2003). In an investigation on water use in Benin, (Mason, 2012) reported outcomes like the entrance conditions ordered by Howard and Bartram (2003) – where the volume water increased as the separation over which it was conveyed diminished. This grouping by Howard and Bartram additionally includes gathering time, as it is attached to remove. In their report, Howard and Bartram indicated a most extreme separation of 1,000 meters, past which the administration level was named 'no entrance'.

The quantity of water sourcing points (e.g. hand pumps, collective taps, spots on waterway banks where individuals can achieve the water) in a community isn't obviously defined in writing. The quantity of available points is one angle that can be of incredible incentive for instance in bringing about decreased separation and additionally the related time savings as far as collecting water. The bits of accessible writing likewise concentrate fundamentally on the quantities of public taps. The Sphere Project (2005) prescribes 250 individuals for every tap gave there is a flow of no less than 7 liters of water for each minute at each tap. A South African guideline suggests water point densities of 15-25 taps for each km²(Al-Bader et al., 2009). Notwithstanding, in both these guidelines too the DWA (2004) guideline of water points within 200 meters, the parts of lessened separation and saving time were not the main drivers.

A water supply framework should at any rate have water accessibly consistently for the fundamental water needs of a family (Lucas, 2014). This implies it must be given at an amount for every individual every day at a nice yield of flow rate. Along these lines individuals will have enough water and it is promptly accessible when they have to get to it. An investigation by Gleitsman(Lucas, 2014)showed that community individuals were not willing to pay for the utilization of hand pumps in light of the fact that the flow rate of water from the hand pumps was too low and it subsequently took too long to gather water from the pumps. Such a case shows the influence that flow rate can have on the time it takes to gather water. This flow rate and thus the time it takes to fill a container can likewise have a bearing on the amount of water gathered. For instance, regions in South Africa have been known to utilize 'the dribble' which confines the flow rate of water to keep the utilization of water well beyond the Free Basic Water sum for family units that have not paid for past due records (Peters and Oldfield, et al., 2005).

Unapproved associations, for instance connecting a hosepipe to a public tap, are becoming an increasingly normal sight in South Africa. Seshoka et al. (2004) investigated one town were 1,700 unlawful associations were checked, the greater part of which were being utilized to water cultivate plots(Seshoka et al., 2014). The aftereffect of this will be that that while the 'connectors' have more than their offer of water, the water weight is

lowered to such a degree, to the point that collective taps farthest from the supply run dry (Koekemoer, 2009).

As water-related infectious ailments continue to be of concern especially in the developing scene, a noteworthy concentrate remains on providing water supplies that are microbiologically protected, in spite of the fact that transportability additionally alludes to different parameters, for example, the concoction security of water. This examination concentrated on the wellbeing related microbiological quality as it is considered of more noteworthy worry in water supply quality in developing nations (Division, 2007). It likewise centered around using the nearness of *E. coli* microscopic organisms as a measure of infection chance postured by the water that the general population in the examination region would drink.

2.5 Economic Impacts of Technology in Provision of Affordable and Reliable Water Supply

Water is an important resource for economic development of any given community. Combating neediness is the main test for achieving evenhanded and sustainable advancement and water assumes a fundamental part in connection to monetary development. He continues to contend that poor access to water adds to appetite and sustenance insecurity. A nearby examination and investigation of the thousand years statement affirms the focal part of water and sanitation in sustainable improvement and the real commitment that extended access to safe drinking water and satisfactory sanitation can prompt neediness mitigation. According to Hesselbarth (2005), the arrangement of safe drinking water and fundamental sanitation adds to sustainable upgrades in people groups' lives regarding their wellbeing and training circumstance, the preconditions for gainful work and in addition for the destruction of outrageous yearning and the strengthening of ladies (Hesselbarth, 2015). Fox and Liebenthal (2006) argues that water, sanitation and hygiene are essential for achieving the MDGs- and hence for alleviating global poverty. An investment in the water sector is an investment in all the MDGs(Fox and Liebenthal, et al., 2015). The impact of water sector investments directly targeted at poor consumers is anything but subtle (UN-Water, 2009). Around the world poor people place a high priority on drinking water.

The disparities in water pricing that exist between different the common water sources in Nairobi low-income settlements namely; piped water, water kiosks and water vendors can have significant implications on economic status of the residents. There is a huge difference in amount saved between buying water from water from water vendors which trades from 20 to 30 KES per 20litres whereas the same amount of money in piped water can afford approximately 2000litres.

The weight of water availability includes time spent in the gathering procedure. More than 66% of family units universally bring water from outside the home: regarding assets, distinctive investigations have demonstrated that the look for water may take 2-4 hours day by day, traveling separations of more than 3 Kilometers and carrying heap of between 20-25 Kilograms and actually the capacity of ladies and kids (Alaci and Alehegn 2009). The time and vitality can be utilized as a part of monetarily exercises. For instance, the spared time can be used in different exercises such either beneficial (financial), household, (for example, looking after youngsters, cooking and cleaning), individual (socializing), or improvement and administration related e.g. attending meetings, carrying out gathering work and participating in community exercises (Obiti, 2013). Accordingly providing individuals with a solid and simple open water supply has the capability of increasing the income of households(Obiti, 2013).

Sustainable improvement must be accomplished on the off chance that we initially prevail to get individuals out of destitution. Individuals advantaged enough to live in more prosperous parts of the world once in a while need to face the outcomes of water shortage. For some, individuals living in informal settlements notwithstanding, the stay is extremely troublesome. Inadequate access to water frames a focal piece of individuals' neediness, affecting their essential needs, wellbeing, sustenance security and fundamental employments. Improving the entrance of destitute individuals to water can possibly make a noteworthy commitment towards neediness lightening, (UNESCO, 2003). Water is an utilization require which must be paid for with income gained from monetary exercises (or in time spent collecting it), and is a benefit which can create certain kinds of income in commitment with different assets(Tchobanoglus, 2003). Increased shortage of water incredibly experienced by ghetto occupants, diminish family unit ability to combine

water with different resources keeping in mind the end goal to deliver income. Now and again, youngsters (especially young lady kids) may invest more energy collecting water (and additionally spending a greater amount of it) because of enhanced access (Nations, 2006).

According to WHO (2009) the fundamental conflict, upheld through an extensive variety of contextual investigations is that water administration is a decent investment, would it be able to add to destitution mitigation, as well as can do as such in ways that are reasonable and in many cases, produce riches. Moreover, it has a more prominent potential to advance the strength of neighborhood groups which in turn will contribute essentially to destitution mitigation. Hesselbarth (2005) watches that enhanced water quality will lessen the wellbeing dangers and furthermore the expenses of preventing and treating sick relatives. Besides, the decrease of working days lost to water-related maladies will likewise positively affect the family unit's income circumstance. Many water **project investments in the city of Nairobi have in** one way or another improved on the economic status of many Nairobi dwellers who not only benefit from the supply of clean and safe water for drinking but also it becomes a source of employment and income to the same. An example of such project is “MajinaUfanisi” working with locals of Kibera to provide them with clean and safe community water, as a community project way World Bank (2000).

Another dimension in which adequate water provision can have significant economic influence is on food security. Urban agribusiness is one employment methodology that the urban poor use in combination with different systems (Baud, Post and Furedy, 2016). Urban farming in informal settlements includes nourishment creation, processing and marketing and related exercises, for example, recycling and profitable utilization of the urban waste and waste water. Urban horticulture can react to the sustenance needs of the neighborhood populace, help set up income generating exercises that are open to the urban poor (including youth and ladies) and help enhance the earth (urban greening, waste and wastewater administration).

Studies carried out in different residential settings suggest that improved water generates substantial economic benefits, mainly by saving time and energy. According to a research

by Were (Plan, 2008), done in western Kenya good countries; safe water is generally perceived as both a basic human need and a key input into financial action. There is a potential that arrangement of humble measure of water to smallholder famers can upgrade family monetary generation, spare work time for ladies and young ladies, and enhance family wellbeing. According to Urban Agriculture Magazine (2009), vegetables from the sacks are utilized for utilization or they are sold, along these lines increasing a family unit's entrance to money for different necessities and for instruction of the kids. Families that are producing vegetables can set up a full feast a few times each week. By and large, every family unit additionally increases its week by week income by 5 USD(Baud, Post and Furedy, 2016). Given that house rental in Kibera costs around 6 USD/month, this extra money speaks to an imperative wellspring of income. Families with access to at least three sacks have evaluated income of around 33 USD every month, which is more than the normal month to month income per family(Baud, Post and Furedy, 2016).

Francis and Verhagen (2005) carried out a study in Banaskantha District western India on economic and gender benefits from domestic water supply. The study was carried out in two villages, the enterprise and control village. In the enterprise village there was domestic water supply while in the control village there was no domestic water supply. The study made the following findings. That water collection was time consuming and by and large a family unit spent about five hours daily on collecting water. This is on the grounds that their channeled water was poor supply and generally separated for drawn out stretches of time. The findings additionally demonstrate that ladies from big business town invested more energy in income generating exercises than ladies in the control town. Such exercises included; use savings exercises, - including working without anyone else land and income generating exercises, - either by hiring themselves out as day by day wage workers or through doing small scale venture work.

2.6 Challenges of using Technology for Provision of Affordable and Reliable Water Supply

There are many challenges that can inhibit the adoption of environmental technology in developing countries. Some of these are relevant to all countries (both developing and

developed) – for example, feeble market request, uncertain degree of profitability, and mechanical secure to current infrastructure. Others, notwithstanding, are more particular to developing nations, such powerless security of intellectual property, and to technology selection, for example, the absence of specialized aptitudes and limit. A recent study addressing technologies for the renewables sector, highlighted key challenges to environmental technology transfer. While some of these are specific to the renewables sector – like remoteness of infrastructure and higher costs of connection for small-scale production – other barriers to administrative, regulatory, market, financing and socio-cultural conditions – such as poor co-ordination between regulators and lack of subject experience among investors – and are more generally applicable

As environmental change brings about movements in water free market activity, groups should grow, decrease, or reconfigure their water infrastructure frameworks, including through innovative open private associations, bringing together the federal government with local, tribal, and state governments, special authorities like irrigation districts, and the private sector. In recent years, the Federal government has explored ways to expand financing options for public sector infrastructure through increased private investment, such as through its Build America Investment Initiative (BAII) established by President Obama in July 2014. As the largest federal investors in water infrastructure, the United States Department of Agriculture (USDA) and the Environmental Protection Agency (EPA) have opened Build America finance centers. These centers – USDA’s Rural Opportunity Investment Initiative and EPA’s Water Infrastructure and Resiliency Finance Center – are staffed with financial experts and focus on outreach to the private sector and developing new ways to leverage the Federal government’s existing investments in water projects

The broad disappointments in innovative water supplies have been ascribed to a number a blemishes in the tasks' plans; the intervention not being wanted by the community, high capital or potentially intermittent expenses for the community to shoulder or sustain, or absence of proprietorship, resulting in inability to hold up under the expenses and hence disregard of maintenance and repairs. The guaranteed benefits don't appear, instruction projects to bring issues to light are too short and trained individuals from the community

frequently move away or lose interest (Carter and Howsam, 2008). Repel Jonnes, 2001 gives different components undermining availability such include the on-going utilization of conventional wellsprings of water, poor frameworks of cost recuperation and the dislike for the water from the enhanced source.

Commonsense reactions to the test of availability are being tried and utilized by improvement specialists the world over. Because of the across the board slant in developing nations of the devolution of obligation regarding water plans from governments to villagers, a considerable lot of the interventions went for improving availability are taking spot at the town level. The utilization of fitting innovations, which are low in cost, simple to maintain, easy to utilize, and promptly accessible is one reaction to the test of poor openness. Be that as it may, technology alone can't give access to clean water, as social factors, for example, conduct, wellbeing, and culture can work either in show or against even the best planned execution procedures. Some in the field of water improvement and supply recommend that interventions and water benefit programs in the United States and abroad need to consider these social variables and furthermore need to include the groups in the outline, usage, and assessment of the projects (SantanielloNewton and Hunter, 2000)

2.7 Theoretical Framework

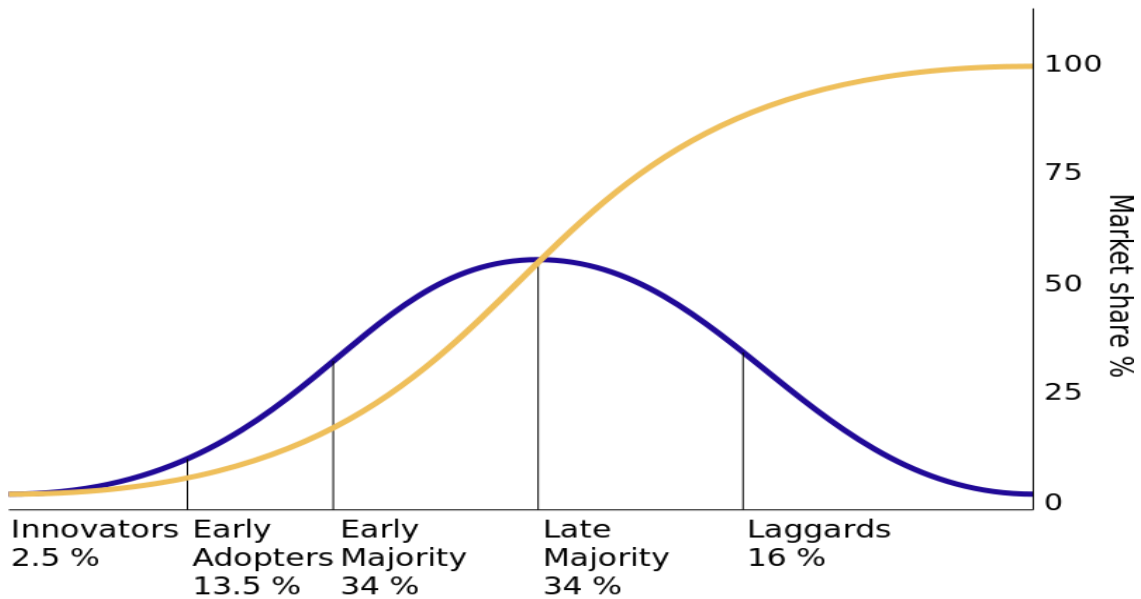
2.7.1 Diffusion of Innovation Theory

Diffusion is the procedure by which an innovation is conveyed through certain channels after some time among the individuals from a social framework. Diffusion is an uncommon kind of correspondence worried about the spread of messages that are seen as new thoughts.

Diffusion of innovation hypothesis investigate examines how thoughts are spread among gatherings of individuals. Diffusion goes past the two-advance flow hypothesis, centering on the conditions that increase or lessening the probability that an innovation, another thought, item or practice, will be embraced by individuals from a given culture. In multi-

step diffusion, the opinion pioneer still applies a huge influence on the conduct of individuals, called adopters, however there are likewise different intermediaries between the media and the group of onlookers' basic leadership. One intermediary is the change operator, somebody who urges an opinion pioneer to embrace or reject an innovation (Zare, Branch and Branch, 2016).

Figure 1: Illustration of the Diffusion of Innovation Theory (Zare, Branch and Branch, 2016).



This study will explore how the introduction of innovative technologies in the supply of water in the informal settlements to solve societal problems has influenced the uptake of water and sanitation services.

Innovators are anxious to attempt new thoughts, to the point where their wander someness nearly turns into a fixation. Innovators' interest in new thoughts drives them out of a nearby hover of associates and into social connections more cosmopolite than ordinary. As a rule, innovators have significant financial assets, and the capacity to comprehend and apply complex specialized information. While others may view the innovator as rash or daring, it is the dangerous hazard taking that is of notable incentive

to this sort of individual. The innovators in this investigation will influence and set pace for the selection of the innovative advances received by the NCWSC(Knabe, 2012).

Early adopters have a tendency to be integrated into the nearby social framework more than innovators. The early adopters are thought to be localites, versus the cosmopolite innovators. Individuals in the early adopter class appear to have the best level of opinion authority in most social frameworks. They give guidance and information looked for by different adopters around an innovation(Knabe, 2012). The early connectors are normally regarded and have notoriety for fruitful and discrete utilization of new thoughts and henceforth fill in as the change operators and they help speed the diffusion procedure to whatever remains of the individuals within the informal settlements.

Individuals from the early larger part classification will receive new thoughts just before the normal individual from a social framework. They interact much of the time with peers, yet are not frequently discovered holding administration positions. The early dominant part go about as the link between early adopters and individuals late to embrace the new water innovations. They have an essential impact in the diffusion procedure since they ponder some time before totally adopting another thought. From time to time leading, the early lion's share adopters willingly follow in adopting innovations and they will frame most of the individuals willing to take up any new ideas(Knabe, 2012).

The late greater part are a doubtful gathering, adopting new thoughts soon after the normal individual from a social framework. Their reception might be a result of financial need and in light of increasing social weight. They are careful about innovations, and are hesitant to embrace until the point that most others in their social framework do as such first. An innovation should definitely have the heaviness of framework standards behind it to convince the late dominant part. While they might be induced about the utility of an innovation, there must be solid weight from associates to embrace (Rogers, 1971).

Slow pokes are traditionalists and the last to embrace an innovation. Possessing no opinion authority, slouches are localite to the point of being disconnects contrasted with the other adopter classifications. They are focused on the past, and all choices must be

made as far as past ages. Individual slouches mainly interact with different traditionalists. An innovation finally received by a slouch may as of now be rendered out of date by later thoughts as of now in use by innovators. Loafers are probably going to be suspicious of innovations, as well as of innovators and change specialists too. These are the minority of the groups and individuals who might oppose the introduction of the water innovations.

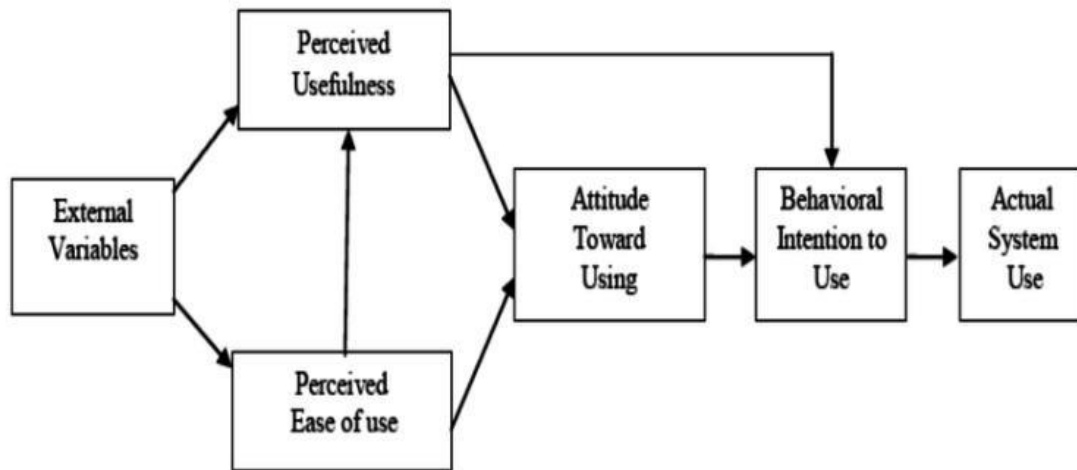
2.7.2 Technology Acceptance Model (TAM)

Technology Acceptance Model (TAM) gives a substantial and solid measure that predicts the acceptance or appropriation of new advancements by end-clients (Davis 1989). It additionally is a generally utilized model to quantify technology acceptance (Lee, Kozar and Larsen, 2003). This model manages perceptions instead of genuine use, proposes that when clients are given another technology, two essential variables influence their choice about how and when they will utilize it. That predicts acceptance in view of the end-client's apparent helpfulness (PU) and saw usability (PEOU) of the technology for a particular reason. PU is defined as "how much a man trusts that using a specific framework would upgrade his or her activity execution." PEOU is defined as: "how much a man trusts that using a specific framework would be free of exertion". Here, PEOU's definition, not at all like PU's, rises above work settings and in addition objectives or purposes (Lee, Kozar and Larsen, 2003).

The model is originally intended to anticipate client's acceptance of Information Technology (IT) and utilization in a hierarchical setting. Cap concentrates on the state of mind clarifications of intention to utilize a particular technology or administration; it has turned into a broadly connected model for client acceptance and utilization. There are various meta-examinations on the TAM that have exhibited that it is a legitimate, hearty and capable model for predicting client acceptance (Bertrand and Bouchard, 2008). One of the impediments of TAM is that it was intended to be utilized as a part of a hierarchical setting instead of in regular day to day existence setting. Past research has recommended that trust-related develops and asset related builds ought to be the basic precursors of the behavioral intention to utilize information frameworks. Moreover, TAM expresses that apparent usability will directly affect apparent handiness (Lee, Kozar and Larsen, 2003).

This study will explore the perceived perceptions of the communities living in the informal settlements of Mathare and Kahawa on the introduction of innovative technologies in the supply of quality water services.

Figure 2: Illustration of the Technology Acceptance Model (TAM)(Lee, Kozar and Larsen, 2003).



2.7.3 Theory of Planned Behavior

The Theory of Planned Behavior (TPB) predicts an individual's intention to take part in a behavior at a particular time and place. It places that individual behavior is driven by behavior intentions, where behavior intentions are a component of three determinants: an individual's disposition toward behavior, subjective standards, and saw behavioral control (Ajzen, 2011). Behavioral Intention is an intermediary measure for behavior. It speaks to a man's inspiration in the feeling of her or his cognizant arrangement or choice to play out certain behavior(Hargreaves, 2011) (Conner and Armitage, 1998).It is determined by the accessibility of abilities, assets, and openings, and the apparent significance of those aptitudes, assets, and chances to accomplish results.

Disposition toward the behavior is a man's general assessment of the behavior (behavioral conviction). It is accepted to have two segments which cooperate: convictions about outcomes of the behavior and the corresponding constructive or contrary judgments about highlights of the behaviour(outcome assessments: If I were to participate in this

specific behavior, will the outcomes be desirable?). Subjective standards are a man's own gauge of the social strain to play out the objective behavior (regularizing convictions) subjective standards are expected to involve convictions about how other individuals, who might be somehow vital to the individual, might want them to carry on (standardizing beliefs). Perceived behavioral control is the degree to which a man feels that he/she can order the behavior (control convictions). It has two angles: how much a man has control over the behavior, and how certain a man feels about being ready to perform or not play out the behavior. It increases when individuals see they have more assets and confidence (Ajzen, 2011) (Lee, Kozar and Larsen, 2003).

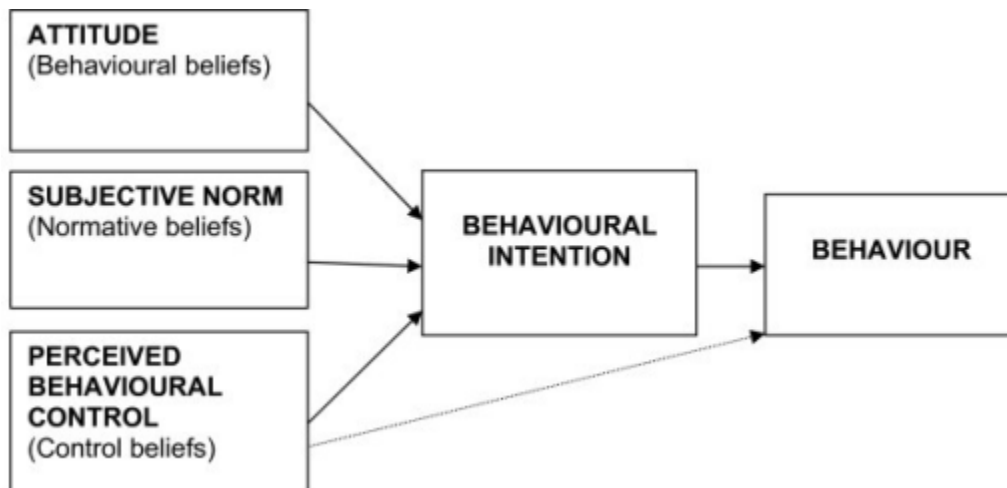
As Kriponant (2007) underscored, by changing these three indicators (state of mind, subject standard and saw behavior control), the possibility that the individual will intend to complete a coveted activity can be increased and hence increases the shot of the individual really doing it. In their separate totals, behavioral convictions deliver a great or troublesome state of mind toward the behavior; regularizing convictions result in apparent social weight or subjective standard; and control convictions offer ascent to apparent behavioral control. In combination, state of mind toward the behavior, subjective standard, and perception of behavioral control prompt the arrangement of a behavioral intention (Ajzen, 2011). When in doubt, the more ideal the demeanor and subjective standard, and the more noteworthy the apparent control, the more grounded ought to be the individual's intention to play out the behavior being referred to. Finally, given an adequate level of genuine control over the behavior, individuals are required to do their intentions when the open door emerges. Intention is along these lines thought to be the quick predecessor of behavior. Notwithstanding, in light of the fact that numerous behaviors posture troubles of execution that may confine volitional control, it is helpful to think about apparent behavioral control notwithstanding intention. To the degree that apparent behavioral control is veridical, it can fill in as an intermediary for genuine control and add to the forecast of the behavior being referred to (Ajzen, 2011).

Exactness of the new convictions speaks to the information individuals have about a behavior: its probable results, the regularizing desires of others, and the feasible obstacles to its execution. Behavioral interventions give information that change some of these

convictions, or that prompt the arrangement of new convictions. We might have the capacity to change demeanors, subjective standards, or perceptions of behavioral control by providing effective however inaccurate information significant to these elements. For the time being, this may really be very compelling in that we may see behavioral articulations of the progressions created by the intervention. In the long run, notwithstanding, individuals will understand that the guaranteed outcomes don't emerge, that vital referents don't generally anticipate that them will play out the behavior, or that they don't, all things considered, have the required abilities and assets to perform it. Therefore, intentions and behavior will frequently return to what they were preceding the intervention. Just when the new convictions precisely reflect reality would we be able to expect that the impact of the intervention will hold on after some time(Iverset *al.*, 2010).

This study will explore the perceptions of the communities living in the informal settlements on how the innovative water technologies influence their attitudes, subjective norms, and their behavioural control in the adoption of the new technologies. The study will explore if the innovative technologies resonate with their beliefs and whether they perceive the technologies to improve their lives which would determine whether they would change their behaviour in accepting and adopting the innovative technologies.

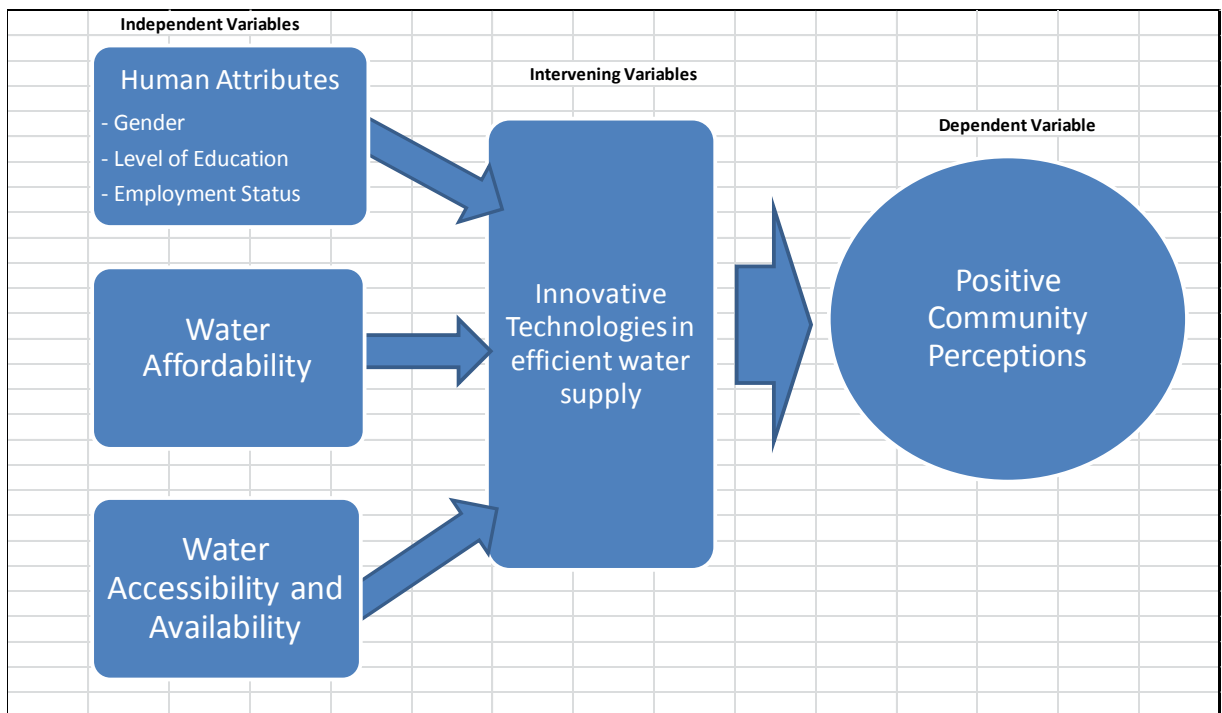
Figure 3: Illustration of the Theory of Planned Behavior (Kluger and Denisi, 1996)



2.8 Conceptual Framework

In this research, the conceptual framework is the compact portrayal of the marvel under examination joined by visual delineation of the factors under investigation. This study will evaluate the how the water consumers living in the informal settlements perceive the introduction of technological interventions in providing reliable water supply. These perceptions will be affected by the new technologies, the payment of water and also how their general feeling about the introduction of such projects of proving reliable water supply.

Figure 4: The Conceptual Framework



Introduction of innovative technologies in the provision of quality water supply in the informal settlements in Nairobi is likely to affect perceptions of low income communities on the provision of quality water. The independent variables of access, human attributes and affordability would determine how the communities perceive the introduction of

technologies in the water supply. Positive outcomes will be expected in the study because the technology reduces the price of water, trains the consumers on how to apply the technology in accessing water and also increase access due to the operation of the legal water points.

CHAPTER THREE: RESEARCH METHODOLOGY

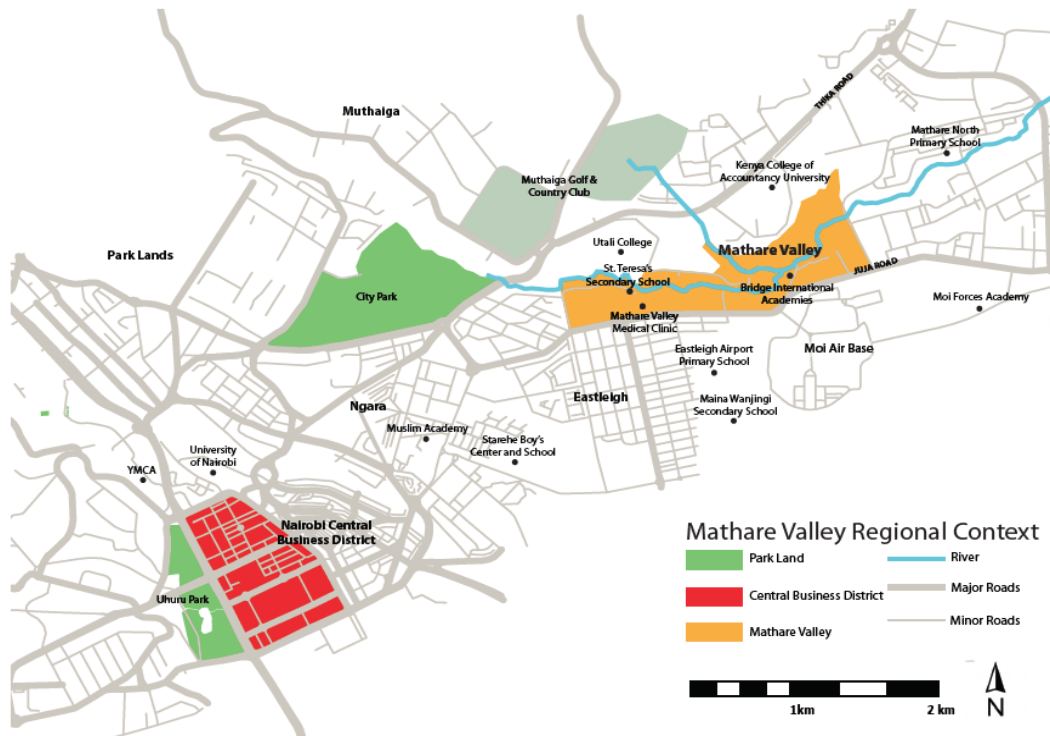
3.1 Introduction

This chapter described the methodology that was applied to explore the perceptions of the communities living in the informal settlements in Nairobi towards the provision of affordable and reliable water supply in Nairobi's informal settlements. This section described the study design, the study sample, and the tools and procedures that were used in the study. It also elaborated how data was collected and analyzed for the results.

3.2 Study Site Description

Two locations Mathare and Kahawa Soweto were chosen for the study (See Figures 1 and 2 respectively). The first area Mathare Valley is one of the biggest informal settlements in Nairobi and East Africa. The zone needed fundamental administrations, including water, sanitation and power for a lion's share of its inhabitants. Mathare informal settlement is home to more than 700,000 individuals occupying a zone of two miles in length by one mile wide and lies roughly 6 kilometers toward the upper east of Nairobi's focal business locale and is circumscribed by Thika Road toward the north and Juja Road toward the south. The Mathare informal settlement sits within a valley of the Mathare and Gitathuru Rivers. Mathare is one of the most seasoned and biggest informal settlements in Nairobi (Trust, Planning and Planning, 2012).

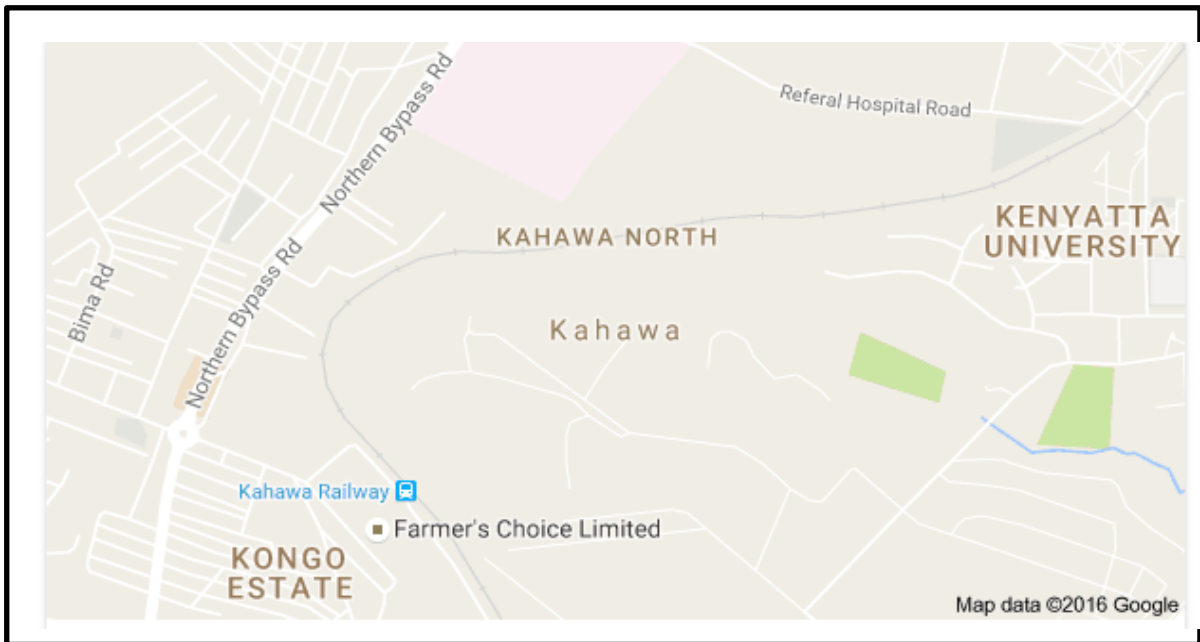
Map 1 : The map of Mathare, Nairobi Kenya (Corburn and Karanja, 2015)



17

The second study site –Kasarani is located to the Eastern side of Nairobi with distance to town ranging from 5 km in Mathare, to 20 km north of Nairobi city centre in Githurai area in Kahawa. Kasarani division is home to many informal settlements which include among them the sprawling Mathare Valley, Kariobangi, Korogocho, Kahawa, and Kindudu. Kahawa Soweto town is a territory named a urban ghetto and found 21 km west of Nairobi downtown area in Kasarani division. It has an expected populace of 7,896 with 2,426 families and spreads a territory of almost 1.8 sq. Kms. The main monetary movement is little retail shops. The main wellspring of income for most properties in the region was from easygoing work in the espresso manors, which was a separation from the settlement, neighboring Kenyatta University and Kahawa west bequest. The people group in the informal settlements had a semi lawful land residency status to the inhabitants. There was an abnormal state of joblessness, which was exacerbated by an expected 15% HIV/AIDS predominance (Reduction, Annual and Report, 2007).

Map 2: The map of Kahawa Soweto, Nairobi Kenya (Saba, 2005)



3.3 Nairobi Water and Sewerage Company

The Nairobi City Water and Sewerage Company (NCWSC) was built up in 2003 because of the Water Act (2002) and began its operations in 2004. Albeit noteworthy upgrades have been set aside a few minutes, NCWSC still faces real difficulties in its administration zone, especially in Nairobi's regularly growing informal settlements. Because of the assortment of infrastructure necessities, water supply and sanitation (WSS) as an open administration represents a particularly troublesome obstacle in these thickly populated zones. The absence of clear guidelines of proprietorship and residency on state-claimed arrive and exclusive housing structures have prompted high occupancy proportions, little confidence later on and heedless answers for arrangement of essential WSS administrations. Indeed, by far most of the 'informal' occupants buy their water from semi-legitimate individual sellers, regularly paying up to 12.5 times more than a Nairobi shopper associated straightforwardly to the system.

NCWSC and the benefit holding element, Athi Water Services Board (AWSB), perceive the predicament of these underserved occupants, however they have not had the ability to deliver administrations to informal settlements. Genuine advances have been taken to fortify their ability, to grow the systems, and oversee benefits in these marginalized regions. A group of sociologists have been utilized to chip away at the social segments of administrations to informal settlements, acknowledging the inadequacy of a simply engineering approach.

A noteworthy positive improvement has been the drafting of guidelines for interventions in informal settlements. These guidelines lay out the guiding principles for reasonable and solid WSS administrations, focusing on community cooperation, organizations with key performers, and adopting appropriate specialized, administration and financial arrangements. The dedication was made open by unequivocally mentioning the informal settlements in the 2008 NCWSC client contract. In its ebb and flow National Water Services Strategy (NWSS) the administration goes for achieving the thousand years improvement objective number 7 by optimizing reasonable and sustainable access to safe water in the settlements of the urban poor. This will be accomplished through defining national benchmarks for low-cost advances and increasing number of open/shared outlets under formal administration arrangement. What's more, the Government of Kenya (GoK) has reacted to the Vision 2030 and the proposal of the "Kenya Economic Recovery for Wealth and Employment Creation (2003-2007)", by commencing a water segment change program with a specific accentuation on the poor similarly prescribed by the Poverty Reduction Strategy Paper (PRSP) which has prompted another institutional and lawful structure and a Sector Wide Approach to Planning (SWAP) in the division.

3.4 Research design

The study employed the cross-sectional design using the survey method to sample individuals that were benefitting from the innovative technologies in water supply in Kahawa and Mathare informal settlements. Cross-sectional plans were basic in outline and were gone for finding out the commonness of a marvel, issue, state of mind or issue

by taking a preview or cross-segment of the populace. This obtained a general picture as it remained at the season of the investigation. The cross segment thinks about involved contact with a piece of the objective investigation populace and they were are moderately shoddy and simple to attempt.

3.5 Data Collection

This research study utilized a mixed method approach to generate both the qualitative and quantitative data. The study utilized 3 methods of data collection namely; survey method which was used to collect quantitative data, and questionnaires was the main tool of data collection. For qualitative data, key informant interviews (KIIs) and Focus group discussions (FGDs) were the main tool of data collection.

The target populations were the households that were being served by the innovative technologies in the provision of quality water services in Kahawa and Mathare informal settlements. The different data collection methods included:

3.5.1 Survey Method

In this study, a survey was conducted to elicit quantitative data. Survey is a research method for collecting data from a selected group of people using standardized questionnaires or interviews (Yin, 1994).

Questionnaires (Annex 1) were the research tools used to explore the perceptions of the communities towards quality water supply in the informal settlements. The questionnaires were administered to the residents of Mathare and Kahawa Soweto informal settlements for the quantitative data. The advantages of using questionnaires were that massive data could be collected at once, which helped in predicting patterns, and the trends of data. A total of 280 questionnaires were administered to the respondents in Mathare and Kahawa Soweto with each interview taking approximately 5 minutes to complete.

3.5.2 Focus Group Discussions

A focus group discussion (FGD) was utilized to assemble individuals from comparative foundations or encounters to examine a particular point of interest. The members were guided by a mediator (or gathering facilitator) who introduced subjects for exchange and helped the gathering to take an interest in an energetic and characteristic dialog among themselves. In this study, the FGD interview Guide was used to lead the discussions. The entire discussions were recorded using an audio recording device. Note taking was done by a trained assistant and the notes written in verbatim. Each FGD comprised of between 8 – 12 participants and it was estimated that the FGDs took an average of one hour, and the modified FGDs an average of 30-45 minutes.

3.5.3 Key Informant Interviews

Key Informant Interviews (KIIs) were subjective top to bottom interviews with individuals who comprehended what was happening in the community. The reason for the key informant interviews was to gather information from community pioneers, experts, or occupants – who have direct learning about the community. These community specialists, with their specific information and understanding, gave insight on the idea of issues and gave proposals for arrangements. Key informant interview guides were the tools used for the qualitative data collection. The respondents and the participants in the KIIs were purposively selected and comprised of community leaders in the two informal settlements and Key Opinion Leaders (KOL) within the informal settlements.

The KIIs provided nitty gritty and rich information that was accumulated in a generally simple and inexpensive way. They allowed the interviewers build up affinity with the respondents and elucidated on questions while providing an open door that reinforced associations with critical community informants and partners. They brought issues to light, interest, and eagerness around an issue and it was anything but difficult to contact the informants to elucidate on a few issues. On the other hand, selecting the "right" key informants could have been troublesome as they spoke to differing foundations and points of view. It was challenging to reach and calendar interviews with occupied as well

as difficult to-achieve respondents and it was hard to sum up results to the bigger populace unless interviewing involved many key informants.

A total of 6 key informant interviews were conducted which included, 2 community leaders, 2 local administrators, 2 project staff. These were persons with experience and knowledge of the project by the NCWSC.

3.6 Sample Selection Procedure

The sample for both the quantitative and qualitative data was selected from the residents being served by the water ATMs and the prepaid water dispensers.

3.6.1 Sample size and Selection Criteria

This study used the area residents as the unit of analysis. The study selected samples from the members of households that were being served by the water ATMs and the prepaid meters in Kahawa and Mathare informal settlements.

3.6.2 Exclusion Criteria

Participants not living in Kahawa and Mathare informal settlements were not sampled or selected for the study regardless of whether they used innovative water technologies.

3.6.3 Sample Size Calculation

The study anticipated interviews from a sample population of 280 from the estimated 1,200 residents currently benefiting from the water ATMs and the prepaid meters in Mathare and Kahawa Soweto informal settlements. We used the Cochran formula (equation) to calculate the representative sample. See also Njoroge, et al., 2013.

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

Where;

n = sample size

$$Z^2 = Z - \text{value for 95\% confidence interval} = 1.96$$

e = is the desired level of precision (sampling error)

p = an attribute of the study population – 24% - estimated proportion of the residents in the informal settlements that have access to water

$$q = 1 - p$$

$$= \frac{(1.96)^2 (0.24) (1 - 0.24)}{(0.05)^2}$$

$$(0.05)^2$$

$$= 280$$

From the calculation, a sample of 280 respondents was to be recruited for administration of questionnaires for the quantitative data collection.

As seen above, P was equivalent to the percentage of population in the informal settlements that had access to water (WSUP 2015). The use of this attribute of water accessibility to the urban poor was because of its relevance to the subject of study. The sample was selected using systematic sampling technique with a random start. This meant that the questionnaires were administered to the Kth respondent/resident (4th respondent) using the prepaid meters and the water ATMs. From the approximate number of 1,200 beneficiaries from the innovative interventions programme a total of 280 participants were sampled.

3.7 Data Analysis

The study generated both quantitative and qualitative data. These two data sets were analyzed as follows;

3.7.1 Quantitative Data

Simple descriptive and inferential statistics were applied to analyze the quantitative data through the Statistical Package for Social Science (SPSS). Quantitative data was

presented in frequency tables, histograms and graphs for interpretation. It turned the raw numbers from the questionnaires into meaningful data through the application of rational and critical thinking which provided quantifiable and easy to understand results.

3.7.2 Qualitative Data

The audio recordings were transcribed and the information collated and the verbatim report carefully studied and the important notes and statements compared among the different FGDs and the structured interviews. Using a qualitative data analysis (QDA) tool the unstructured qualitative data were classified, sorted, and arranged to assist in the process of data analysis in order to develop meaningful and insightful evidence based conclusions.

The qualitative data were grouped in categories and analysis done using a qualitative data analysis tool – NVIVO and also other tools that classified the unstructured data from the FGDs and interviews.

This qualitative data software/program provided a workspace and tools that helped in organizing the transcribed data for analysis. The data was first grouped in to broad categories based on the major concepts and objectives of the study. These broad categories were further divided in to sub categories. From the transcriptions, the related concepts and statements by the community leaders were manually matched with the categories and sub-categories of the intervening functions by dragging the excerpts from the transcripts to the appropriate category in verbatim.

3.8 Ethical consideration

The respondents/residents from the two study sites signed an informed consent which clearly stipulated the obligations, benefits and challenges to the respondents in participating in the study. This was done at the beginning of each interview after a thorough explanation to each respondent of the nature and objectives of study, reason for selection, time to be taken, and risk if any to be incurred.

Respondents were well advised to decline to answer any questions should they have found them incriminating or unfavorable answering. They were advised to withdraw from the study if and when they felt compelled.

CHAPTER FOUR

DATA ANALYSIS AND PRESENTATION AND INTERPRETATION

4.1 Introduction

The findings from the data collected from the two study sites in Mathare and Kahawa Soweto systematically highlighted the demographics and a socio-economic profile of the respondents covering three broad themes namely: Affordability, accessibility and availability and usability. A total of 280 respondents were interviewed using questionnaires, 2 Focus Group Discussions (FGDs) and 6 Key informant Interviews (KII) with community leaders, local administrators, and key project staff for both qualitative and quantitative data.

4.2 Response rate

The sample size for quantitative data was 280 respondents. Those who filled and returned questionnaires were 230 respondents resulting in a response rate of 82%. According to Mugenda and Mugenda (2003), ten percent of the accessible population was a good enough sample size for a research study. Therefore, having a sample size of 280 out of 1,200 residents which represented 24% of the accessible population was a good figure to address the low non-response bias and enable attribution of the results generalizable to the population.

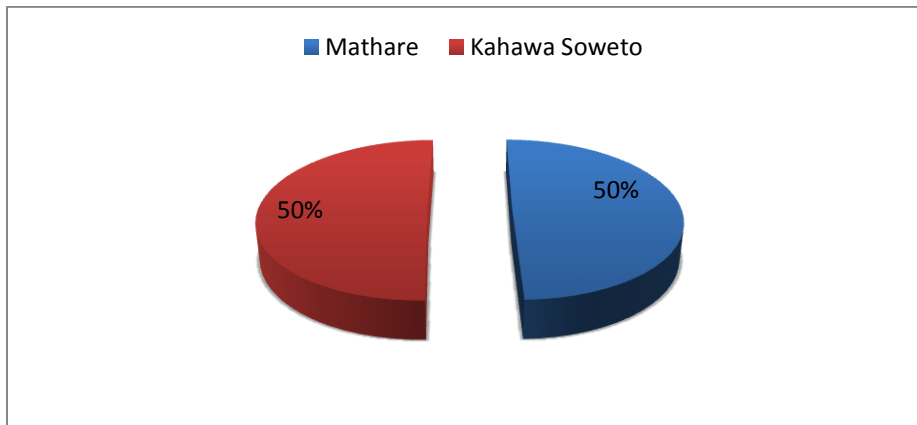
4.3 Social Demographic Characteristics

This study sought to find out the social demographic characteristics of the respondents in order to further examine how these affected their perceptions towards innovative technologies used in water. The information captured included: age, religion, income levels, and marital status.

4.3.1 Residence

The respondents who participated in this study were evenly distributed with 50% living in Mathare and the other half residing in Kahawa Soweto as shown by Figure 7 below.

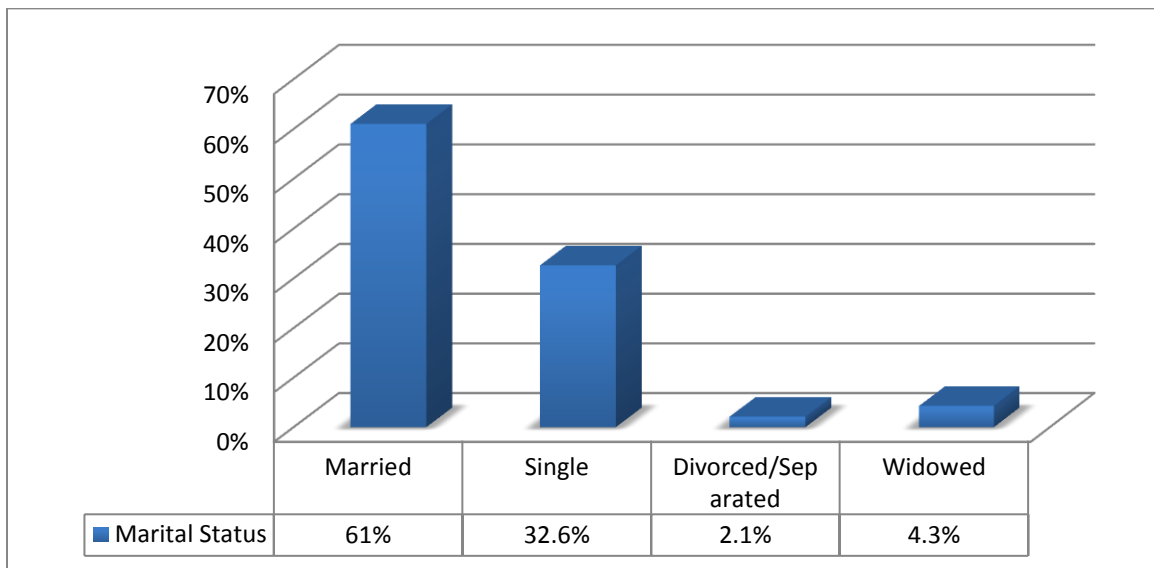
Figure 1: Respondents Residence



4.3.2 Marital Status

Majority of the respondents from the study were married accounting for 61% while those who have either separated or divorced account for the least at 2.1% as shown by Figure 8.

Figure 2: Marital Status



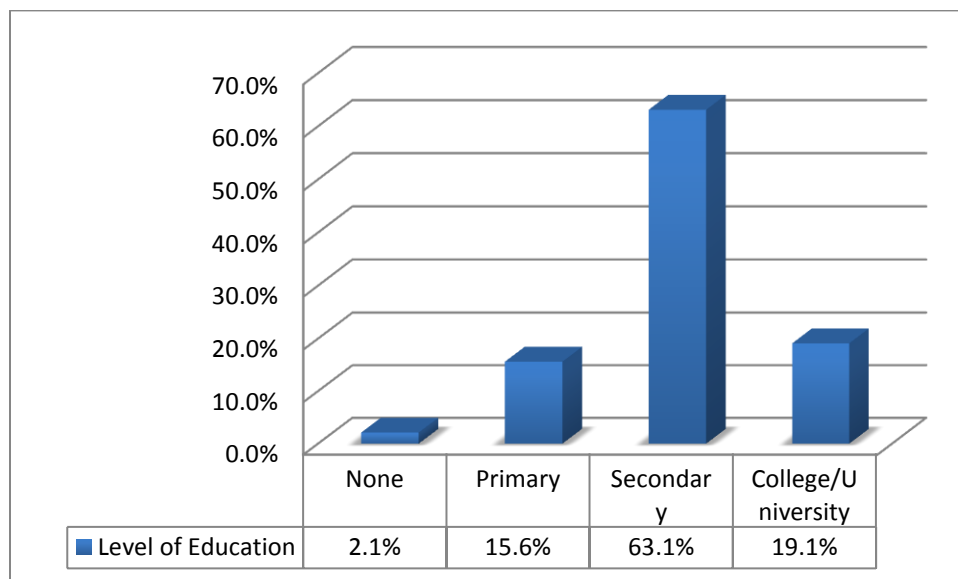
Generally, water was consumed and used in a bigger family setting and hence the perceptions of such family members were important in this study. Larger families consumed more water compared to households with smaller families. Domestic water utilization will probably increase with family unit measure. According to Keshavarzi et al. (2006) and Froukh (2001), both family unit size and piece influence water utilize, and

additionally, family unit estimate has been observed to be the most critical factor affecting water utilization. In the investigation, family measure, the proportion of kids to grown-ups and sexual orientation of the family head are additionally to be considered and in this case larger families were expected to use more water.

4.3.3 Level of Education

It was established from the study that only 2.1% of the respondents did not have any formal education. Majority 63.1% of the respondents had undergone through secondary education as shown by Figure 9.

Figure 3: Level of Education



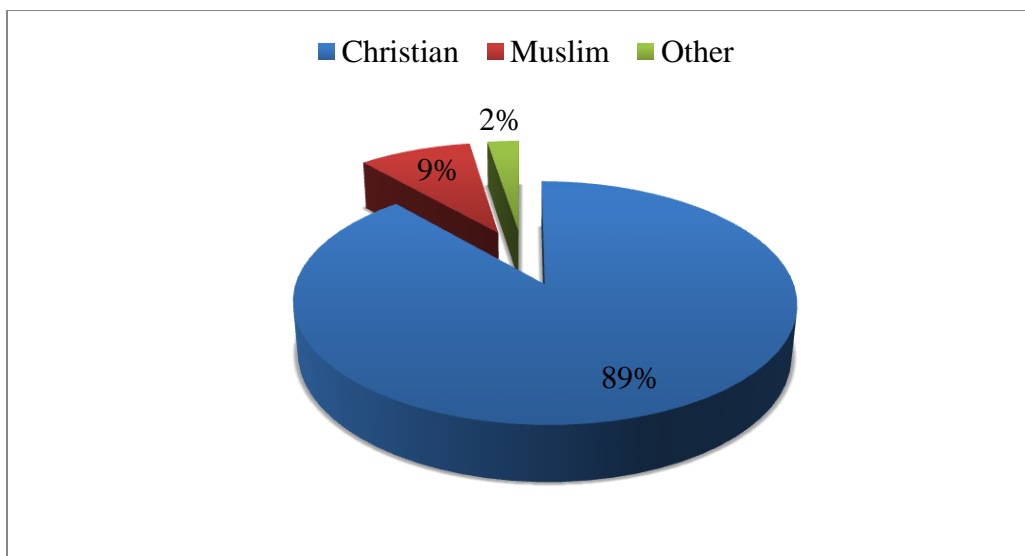
The level of education of the respondents to a larger extent determined their capacity to grasp issues and participate effectively when presented with new technologies within the community. It is expected that, as the level of training increases among family individuals, the level of family unit mindfulness about the medical advantages of water utilize (amount and quality) likewise increases (Keshavarzi et al. 2006; Sandiford et al. 1990). It is along these lines theorized that training level will decidedly influence the level of water utilize and capacity to get a handle on the new technology and utilize it. As an intermediary for training level, we utilize the quantity of grown-ups who have finished essential instruction in the family unit. This variable records for not just the training level

of the family's head, yet additionally those of other family individuals, including the spouses and youngsters.

4.3.4 Religion

The findings from this study showed that majority of the respondents had an affiliation to a religion with majority (89%) being Christians and 9% being Muslims as shown on Figure 10.

Figure 4: Religion



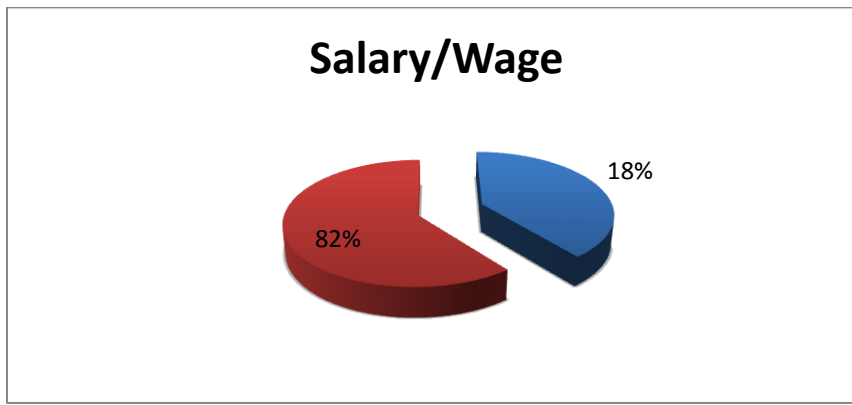
In Kahawa Soweto, it was observed that the Muslim community in the area requested for a prepaid dispenser to be installed near the mosque for ease of use by the worshippers who come to pray.

In Islam water is critical for cleansing and purifying. Muslims must be ceremonially unadulterated before approaching God in petition. A few mosques have a patio with a pool of clear water in the inside, yet in many mosques the ablutions are found outside the dividers. Fountains symbolizing virtue are additionally now and then found in mosques. In Islam custom immaculateness (called tahara) is required before carrying out religious obligations particularly salat (worship) (Abrahams: 2001).

4.3.5 Occupation

As shown on Figure 11, the study findings showed that 82% of the respondents had a regular source of income/wages, 18% reported to have no income/wages or it was irregular. 22% of those with regular incomes were casual labourers, it could be assumed that their occupation to be as a result of the type and level of education that they received which consequently led them to their current status.

Figure 5: Salary/Wage

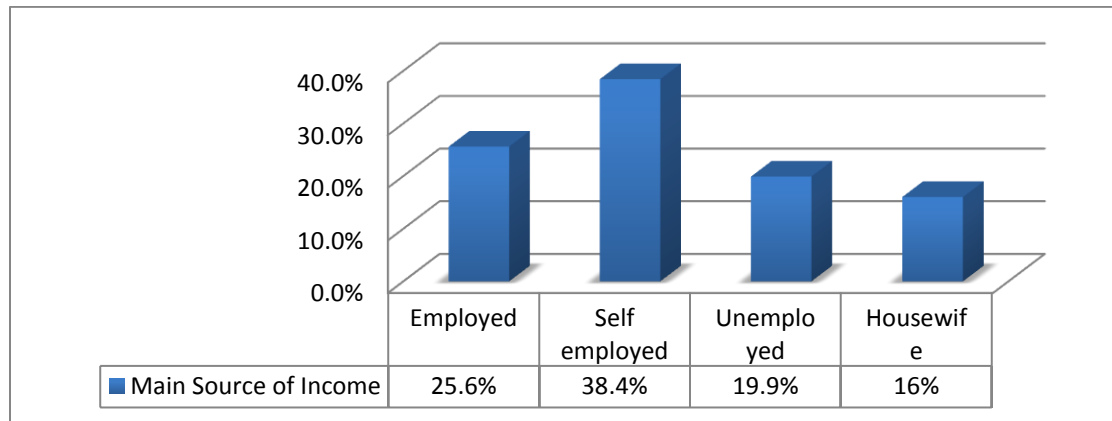


It has been demonstrated that the family head's occupation fundamentally determines the measure of local water utilize, yet the size of the effect relies upon the kind of exercises (Acharya and Barbier 2002).

4.3.6 Source of income

When asked about the main source of income 38.4% reported to be self-employed while 9.9% were unemployed as shown Figure12.

Figure 6: Source of Income



Majority of the respondents from the findings earned less than KES5,000 per month which accounted for 17.7% while only 1.1% earned KES 50,000. It was also worth noting that majority either ran small scale businesses or were casual laborers. This meant that their incomes were not steady and hence subject to the macro economic factors as shown on Table 1 below.

Table 1: Levels of Income

Income(KES)	Frequency (n)	Percentage %
Less than 5000	32	17.7
5,000 - 15,000	99	54.7
16,000 - 30,000	42	23.2
31,000 - 50,000	8	4.4
Total	181	100

The writing has demonstrated a positive connection amongst riches and water utilize (Sandiford et al. 1990). It is expected that destitution adversely influences water utilize in light of the fact that needy individuals cook less and regularly have less clothing to wash.

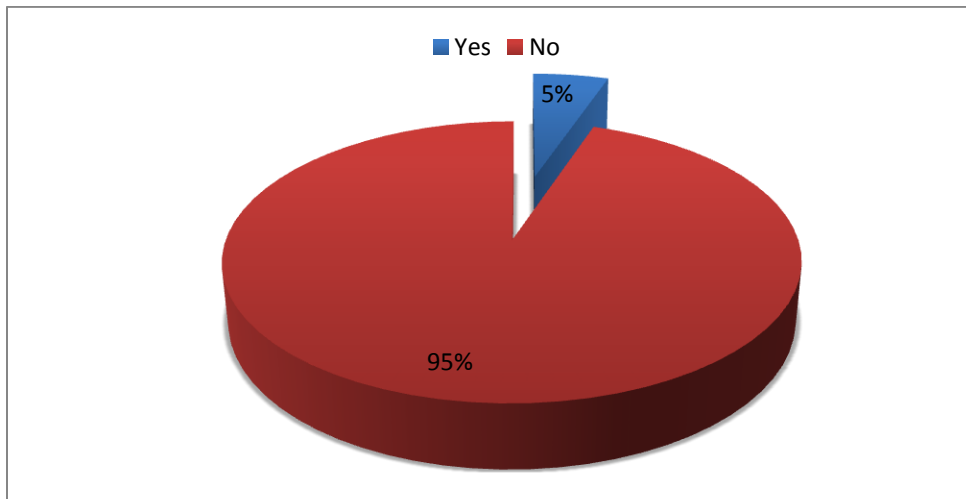
In this investigation, family unit income was utilized as an intermediary for riches. From the examination it can in this way be accepted that moderateness of fundamental needs, for example, water would represent a noteworthy test to the greater part of the respondents.

Another investigation that holds an alternate view to this idea of family unit income expressed that financial improvement writing bolsters the thought that, when dealing with family unit studies in developing nations, family use is a superior intermediary for family welfare than income (Deaton 1997).

4.3.7 Other Sources of Income

The findings from this study showed that an overwhelming majority accounting for 95% of the respondents did not have alternative sources of income thus only 5% have an extra source of income as shown on Figure 13.

Figure 7: Other Sources of Income



The other sources of income included running shops, online marketing, kiosks and being artists as shown below on Table 2.

Table 2: Other Sources of Income

Source	Frequency (n)	Percentage %
Shop	7	70.0
Online Marketing	1	10.0
Kiosk	1	10.0
Artist	1	10.0
Total	10	100.0

Given the small number of respondents involved in more than one income generating activity it can be assumed from the study that most of the residents were either comfortable with their current status or did not have access to capital to start new ventures.

4.4 Affordability

The findings from the study showed that 95% of the respondents were direct users of the Prepaid Dispensers/ water ATMs. This meant that they had a token or water ATM card which they used to fetch water from the prepaid water dispensers.

Figure 8: Direct Users of PPDs

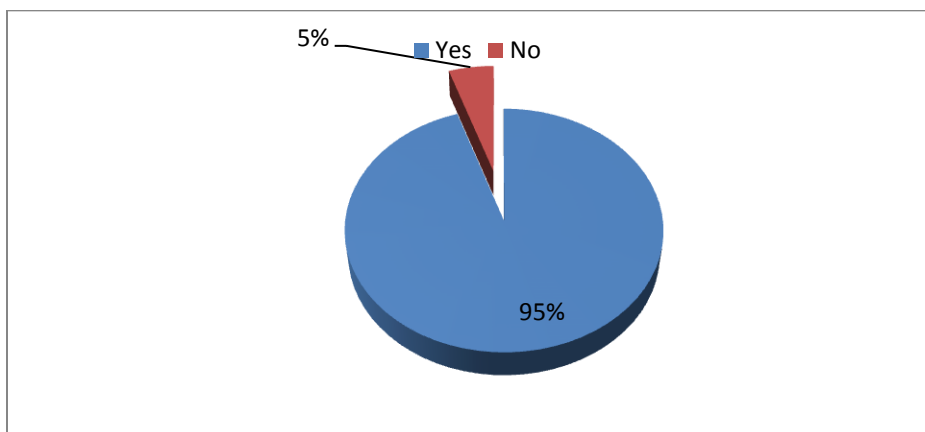


Table 3: Duration for using PPDs/Water ATMs

Duration	Frequency (n)	Percentage %
0 - 6 months	25	11.4
7 - 12 Months	140	63.9
1.1 - 1.5 years	46	21
1.6 - 2 years	8	3.65
Total	219	100

From the FGDs it was evident that residents were happy with the current water rates from the prepaid dispensers. The community thanked the company for initiating such a project which has really transformed their lives. This was attributed to the availability of cheap water which they accessed at 50 cents per 20 litres jerrican as opposed to the KES 5 they would pay for the same from the water vendors and was subject to fluctuations without notice. Prepaid water also meant that the residents could now have a separate budget for water and load their tokens every fortnight or even monthly since the water prices were constant and affordable.

4.3.1 Unregistered PPD Water Users

Findings from the study showed that some of the respondents had not yet registered in order to get a water token/ATM card for fetching water. When probed further for the main reason they did not have a token majority of those who had not registered cited lack of money for the initial registration as the major reason. They accounted for 6 out of 14 respondents as shown on Table 5 below. In addition, results from FGDs and KIIs amplified and underlined the issue of money as a major obstacle to getting services within the informal settlements.

Table 4: Reasons for Not Registering

Reason	Frequency(n)	Percentage %
Lack of Money	6	54.6
Lack of required documents	2	18.2
I use my relatives card	1	9.0
They are not available	2	18.2
Total	11	100

From the key informants interviewed for this study a staff from the water company stated that;

“An officer attached to the project who was interviewed reported that the water company realized that there was a gap in cases where the consumers did not have money to purchase the token and were easily creating another cartel in the prepaid water business and for this reason it was recommended that tokens be issued for free for all residents of the informal settlements. This is expected to greatly increase the token uptake and have a lot more people who are able to afford the water, it will also ensure that unscrupulous water vendors are not able to exploit the consumers as they have done in the past and turned community geared projects into business such as they lost their initial intention”.

4.3.2 Water Charges

Findings from this study showed that an overwhelming majority (97%) were aware of the current water rate charges as the chart above shows. In addition, majority of the respondents paid 50 cents to get water as the figure 15 shows.

Figure 9: Water Charges Awareness

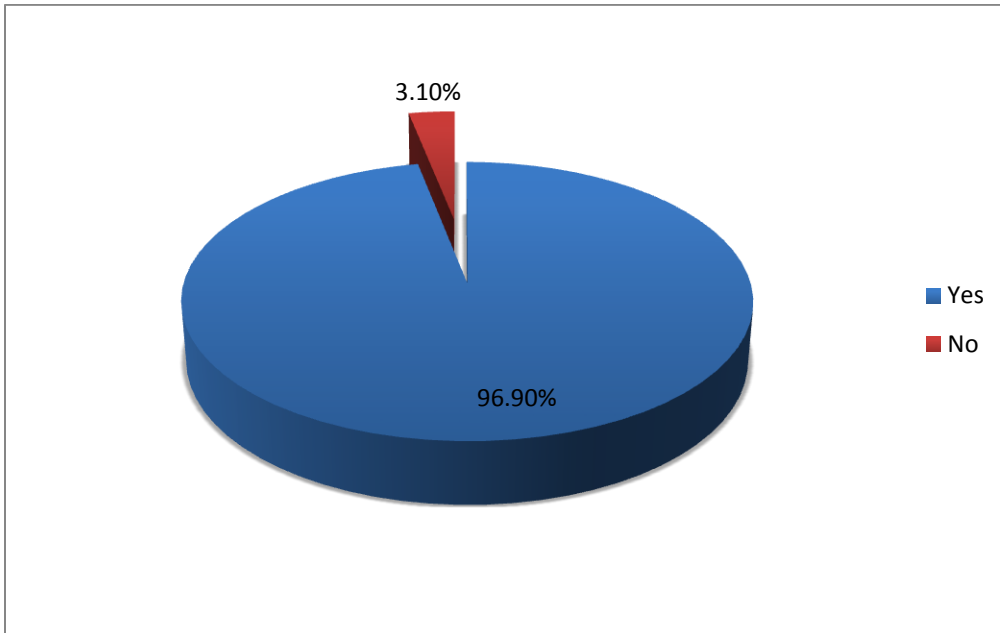
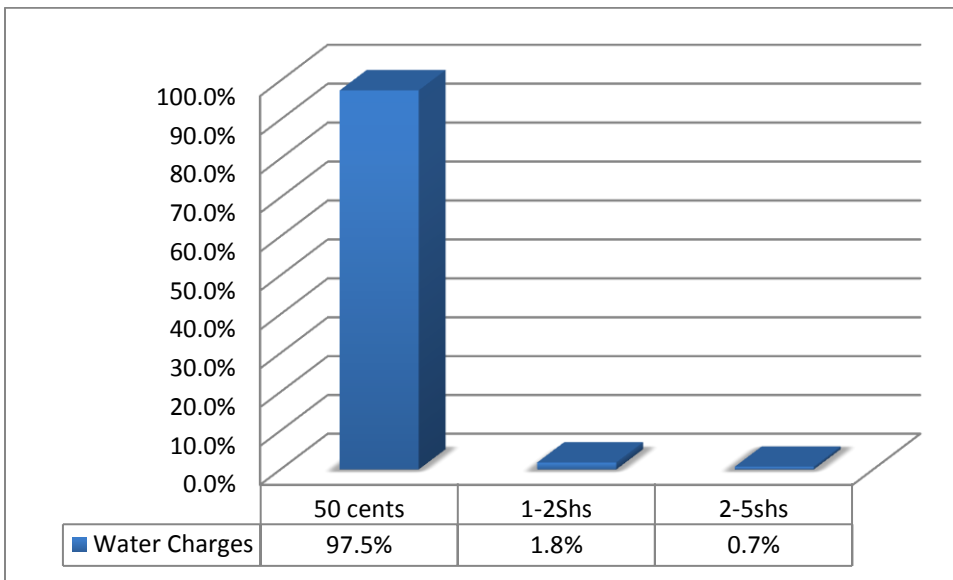


Figure 10: Actual Water Charges



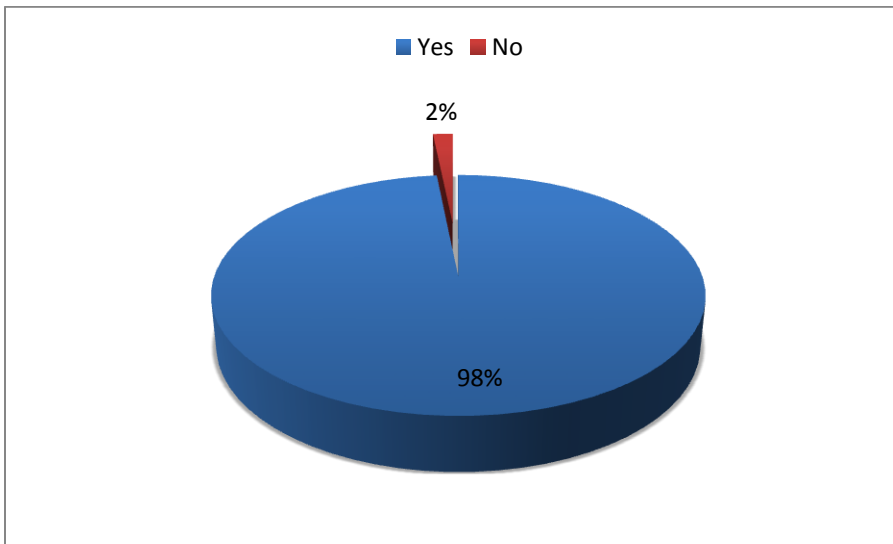
Information from the respondents interviewed in the FGDs indicated that communities were aware that NCWSC approved rates at the PPD were 50 cents, as long as the respondents had a token; the water rate is constant. This was a great incentive to the residents who were used to having fluctuating water prices. NCWSC officers also noted that the company has over the recent years formed a region specifically to deal with water

and sanitation in the informal settlements and has gone ahead and employed community development assistants who were stationed in the various villages and were the direct linkage between the company and the community. This has helped along way in community engagement and sensitization. This direct has also improved the relations between the community and the company which has not been the case for a long time.

4.3.3 Affordability Perception

It was important to evaluate people's views on a project that directly affected their lives in order to be well informed on areas that needed improvement or clarification. The findings in this study showed that 98% believed that water offered at the ATMs or PPDs was affordable.

Figure 11: Is The Water Affordable?

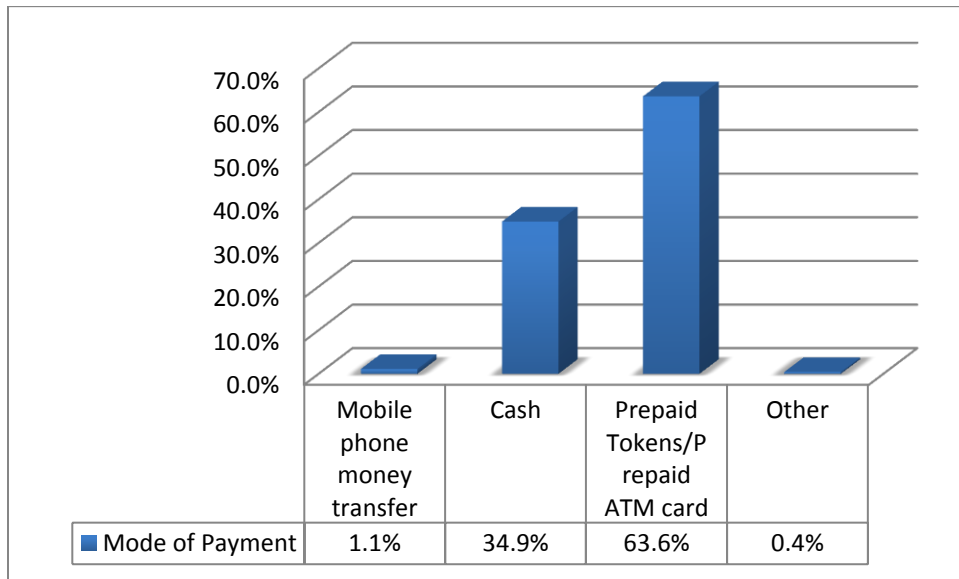


From the FGDs the 2 groups interviewed agreed that 50 cents was the cheapest amount paid for water or any other service in the informal settlements. It had made water affordable even to those who did not have steady incomes, who are a majority in the informal settlements. With as little as 50 cents the respondents could get a 20 litre jerrican of water, Water is a resource that has no alternatives and as such it is important that it is as affordable as possible.

4.3.4 Mode of Payment

Another important aspect that was used to measure the success of the project was the ease with which users paid to access the water services. Majority of respondents as shown on the figure 18 below payments through the prepaid tokens/ATM card accounted for 63.6% of the respondents.

Figure 12: Mode of Payment



As reported from the KII with the project officer in charge of the project, a community development assistant (CDA) connected the office and the customers whenever they were supposed to recharge their tokens. A token recharge tariff was as low as KES 50. Majority of the clients didn't go to office for token recharge but solely depended on the CDA to help them in recharging their tokens. The clients too were not able to access the water from the dispenser once the credit is exhausted. It was the role of the CDA to advise community members not to wait until it's completely depleted. However, as with any technology sometimes the recharging machines could breakdown which forced the residents to pay for cash from either water vendors or other residents with the tokens.

4.3.4.1 Further Analysis on Mode of Payment

To establish the relationship between the perception of the respondents on the affordability of water offered and mode of payment, the use of crosstabs was necessary to measure the level of this relationship. Table 6 below showed that an overwhelming majority of the respondents who paid for this service through prepaid tokens, mobile money and cash found the service affordable at 98.4% thus showing a strong relationship between affordability and mode of payment.

Table 5: Mode of Payment and Affordability

			How do you pay for the water services?				Total
			Mobile phone money transfer	Cash	Prepaid Tokens/Prepaid ATM card	Other	
Is water offered at the water ATM and PPD affordable?	Yes	Count	1	86	161	1	249
		% of Total	.4%	34.0%	63.6%	.4%	98.4%
	No	Count	2	0	2	0	4
		% of Total	.8%	0.0%	.8%	0.0%	1.6%
Total		Count	3	86	163	1	253
		% of Total	1.2%	34.0%	64.4%	.4%	100.0%

4.3.5 Perception on the New Technology

Majority – 93% of the respondents as shown by the findings found the new technology affordable. Furthermore, 93% and 96% of the respondents believed that it was good and convenient respectively as the figure 19 shows.

Figure 13: How Do You Find The Technology?

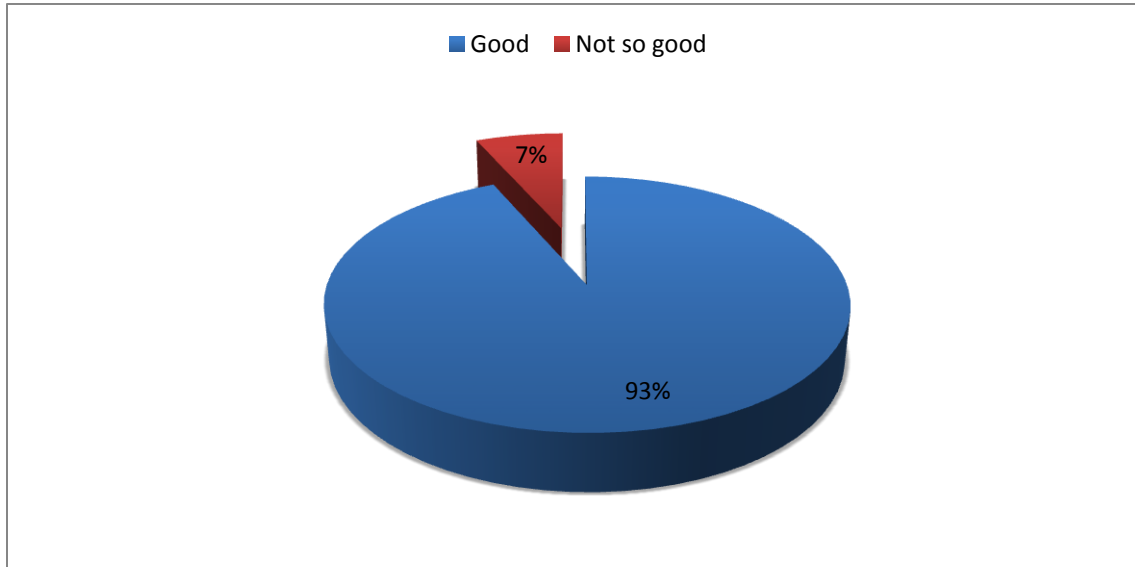
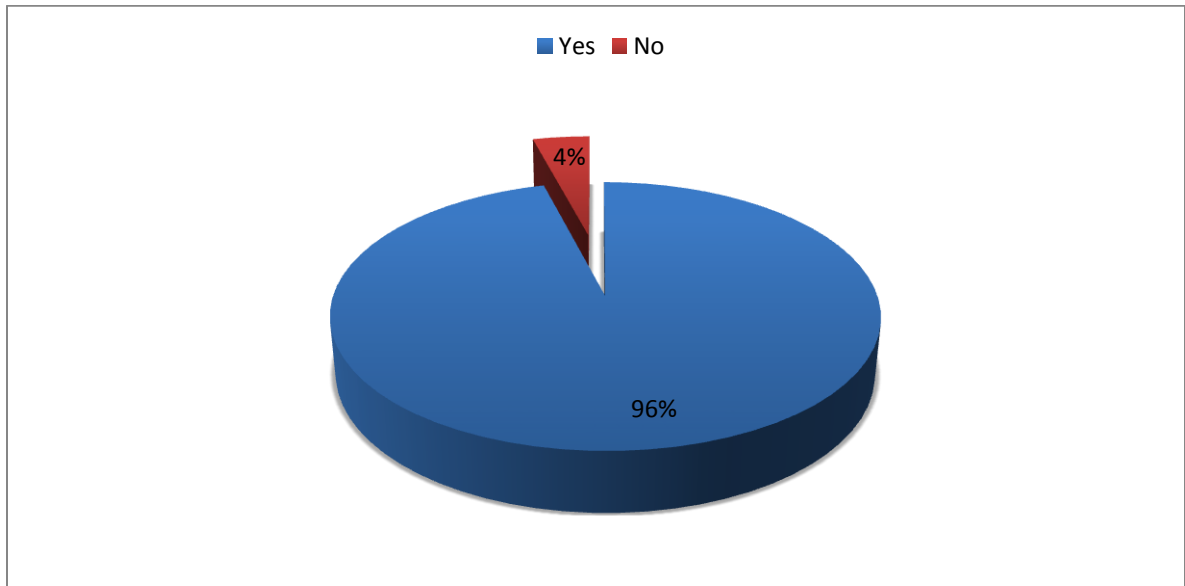


Figure 14: Convenience of the Technology



From this study 93% of the end users cited convenience of the technology as a major reason why they preferred prepaid water solutions. This model managed perceptions instead of genuine utilization, suggesting that when clients are given another technology, two critical variables influenced their choice about how and when they will utilize it. Cap anticipated acceptance in light of the end-client's apparent handiness (PU) and saw usability (PEOU) of the technology for a particular reason. PU was defined as "how much a man trusts that using a specific framework would improve his or her activity execution."

However, some of the respondents did not find the technology convenient with majority (38.5%) citing that the distance from their house to the Water ATM was long followed by 23.1% who found the service not affordable as shown on the table below. This being an informal settlement, there were also concerns on how to put out fires in case they break out.

Table 6: Why it is not convenient

Reason	Frequency(n)	Percent (%)
The water ATM/PPD located far from my house	5	38.5
Sometimes water ATM/PPDs don't work	2	15.4
Putting out fire breakout is a big challenge	2	15.4
There is little water coming from the PPDs	1	7.7
Not affordable	3	23.1
Total	13	100.0

4.3.6 Water prices

Majority – 96% of the respondents agreed that water had become cheaper as per the Figure 21. To further explain these findings, the researcher made use of crosstabs as

shown further below on table 8. Majority of the self-employed respondents found the water cheap accounting 37.6%. However, the greatest indicator on the affordability of this new service was the unemployed respondents where 46 out of 50 agreed that indeed the service was cheap accounting for 17.8%.

Figure 15: Is The Water Cheap

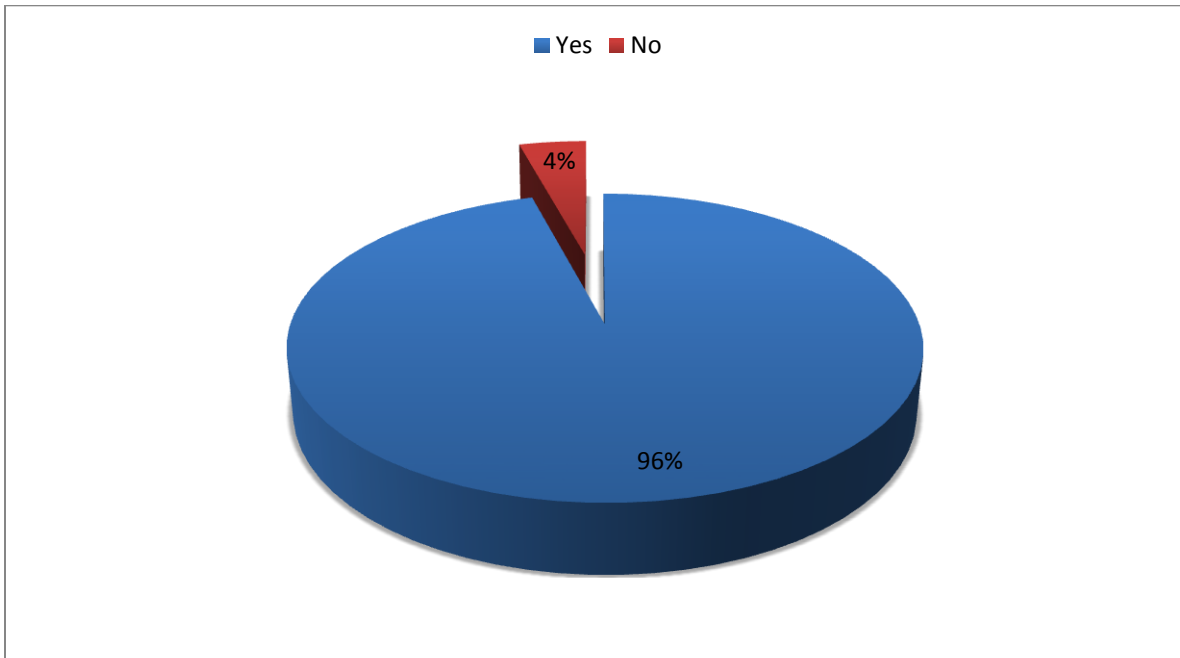


Table 7: Crosstab of Main source of income and Cheapness of Water

		Has water become cheap since you started using the technology?		Total	
		Yes	No		
Main source of income	Employed		67	2	69
			26.0%	.8%	26.7%
	Self employed		97	5	102
			37.6%	1.9%	39.5%
	Unemployed		46	4	50
			17.8%	1.6%	19.4%
Housewife		37	0	37	
		14.3%	0.0%	14.3%	
Total			247	11	258
			95.7%	4.3%	100.0%

When asked about the affordability of the new technology in the provision of water in the informal settlements the residents agreed that it had become significantly cheaper compared to when PPDs were not available.

As one of the village elders stated the new technology was cheaper and reliable as you only purchased the water needed and therefore able to save a lot of money in the long run and use it to pay for other bills.

“Initially, we would spend close to kshs 1000 in a month to buy water or even more on days when it was not easily available. Nowadays, we have cut the cost by up to 90% and therefore, it’s a good idea”.

A female vegetable and fruit vendor further supported this statement and added that;

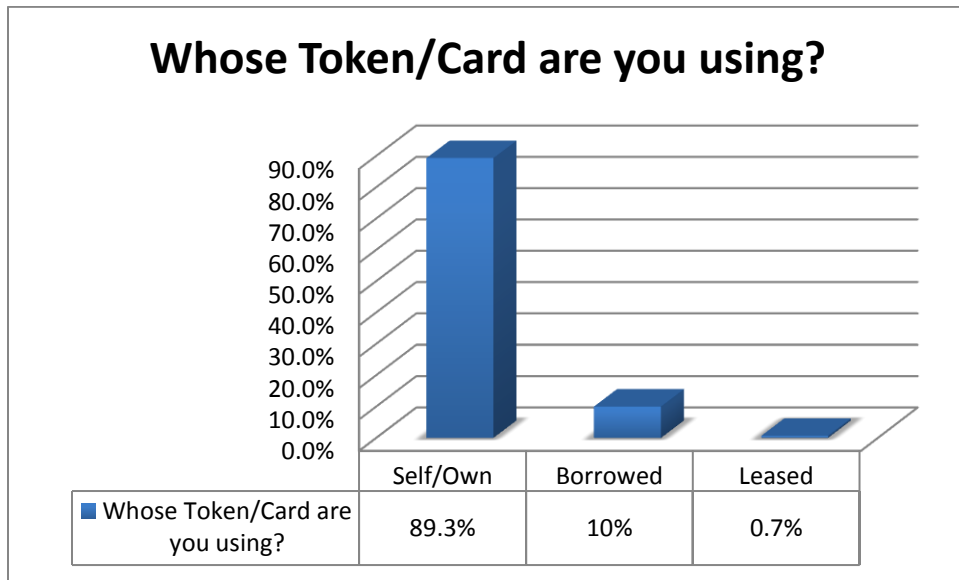
“Before the token water, water prices fluctuated, we were at the mercies of the water vendors/cartels, we would sleep with water being sold at 2shs per jerrican and wake up the next day and find the prices were Kshs 5 and there was nothing much we could do about it since we need the water, we have suffered for a long time”.

A study done in Kibera further compounded the issue of water pricing in the informal settlements, like in numerous different ghettos and shantytowns around the globe, water is rare, expensive, uncertain, and contaminated. Some portion of the explanation behind this is on account of it is an informal settlement that is worked without official approval and direction. In any case, the water emergency in Kibera is especially extreme for some reasons. Because of a combination of political avoidance, the operation of water mafias, water rationing, and poor infrastructure, occupants of Kibera pay more for water than wealthier Kenyans in tapped neighborhoods of Nairobi, and more than even what Europeans and New Yorkers pay. (Crow and Odaba 2009; World Bank 2005). Kibera family units spend up to 20% of their income on water—which can be equivalent to the cost of lease (UNDP 2006)

4.3.7 Ownership of Tokens/Cards

The views on affordability of the water service as shown above on Table 9 positively correlated with the ownership of the tokens because majority of the respondents (89.3%) as shown on figure 22 below owned the tokens/cards that were used for accessing the service. Only 10% and less than 1 percent used borrowed or leased tokens/cards.

Figure 16: Ownership of Tokens/Cards



A lot of community engagement is required for project buy in, one community leader echoed the importance of community involvement and stated that;

“NCWSC has undertaken aggressive community education and outreach programs and activities among the residents to sensitize them on the importance of owning their own tokens as opposed to borrowing or leasing one and these efforts had paid off as most of the households owned a token”.

An officer attached to the project also echoed the importance of community sensitization and stated that;

“The company realized the importance of involving key community leaders and influencers within these communities in prompting the token uptake and also usage, and many consultative meetings were held at the inception of the project to enhance community buy in, even at the implementation stage both the leaders, residents and company have held several meetings to evaluate the progress and challenges encountered so far”.

4.4 Water Accessibility

According to the findings from this study, majority of the respondents found Water ATMs accessible (95%) available (88%) and located nearby (92%) as shown by the above table 9. The minority who found the PPDs inaccessible cited reasons such as distance between the prepaid dispensers and their houses as long, and the PPDs being few compared to demand and lack of water sometimes.

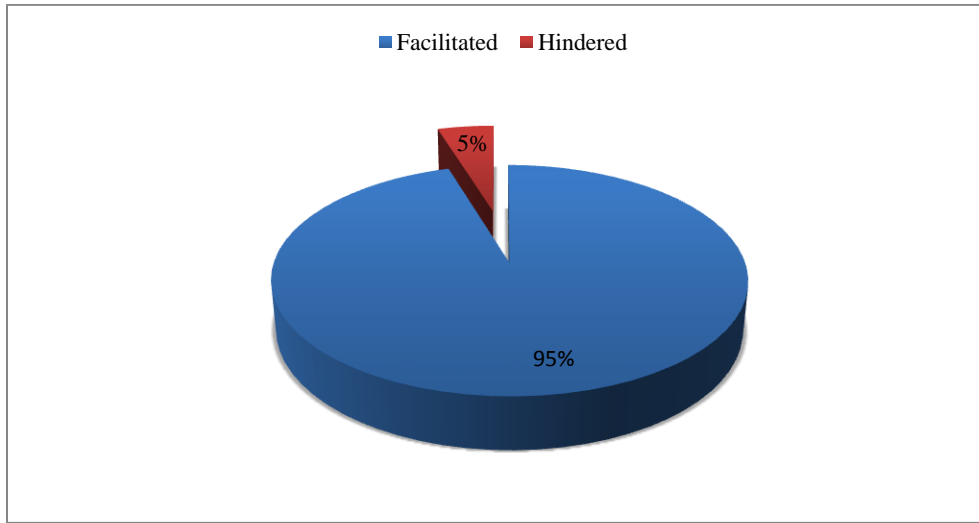
This can further be explained by studies which have shown that, in a territory where individuals depend mainly on open water sources (either free or bought), it is normal that per capita water utilize will diminish as the populace increases. Moreover, individuals in the examination region can just gather a settled amount of water so as to allow everyone to have no less than a little amount of water. In an extensive populace, a family part may need to line a few times previously obtaining the coveted amount. In this way, it can be closed there's a negative connection between populace size and water utilize. Such a speculation has been utilized as a part of a comparative setting by Babel et al. (2007).

Table 8: Location, availability and accessibility

Reasons	Yes	No
Located Nearby	92%	8%
Water Availability	88%	12%
Water Accessibility	95%	5%

Further asked whether the technology had hindered or facilitated use of water, majority 95% confirmed that it had facilitated the use of water as shown by Figure 23 below.

Figure 17: Water Technology Rating



4.4.1 Hindered Use of Water

The respondents who said that the PPDs had hindered the use of water gave reasons such as challenges in putting out fires outbreaks, long queues and the facility not being conducive for the disabled as shown below.

Table 9: Hindrances

Reasons	Frequency(n)	Percent (%)
Challenges in putting out fires	1	9.1
Long queues	3	27.3
Prefer water from taps at home	1	9.1
Not conducive for the disabled	6	54.5
Total	11	100.0

4.4.2 Facilitated Use of Water

The majority – 30% of the respondents who believed the new technology had facilitated the use of water cite reasons such accessibility, availability and affordability as the main reasons as shown on the table below.

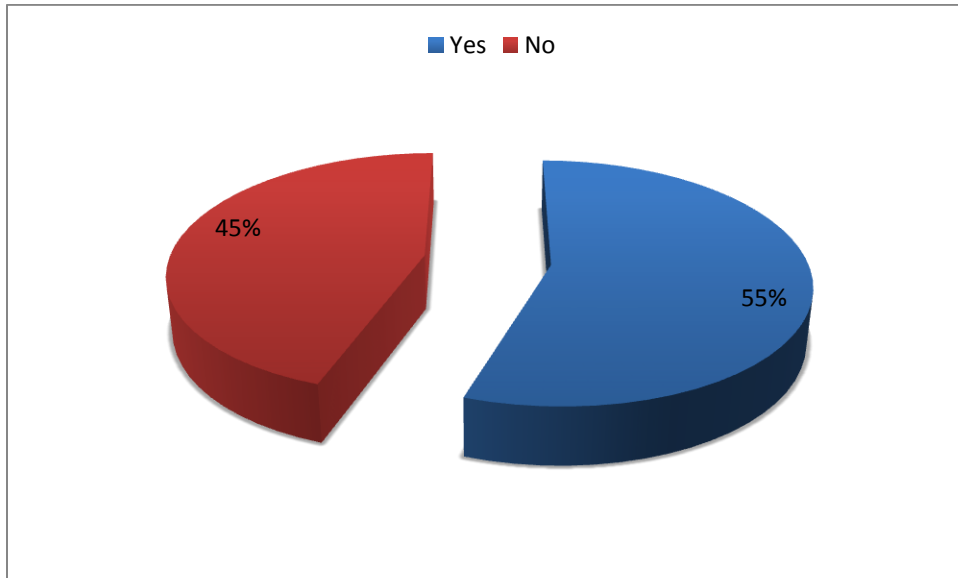
Table 10: Facilitated use of Water

Reasons	Frequency (n)	Percent (%)
It is accessible all the time	51	23.2
Easy to use	13	5.9
Availability of water throughout	47	21.5
Water is clean	25	11.4
Easy to get tokens	11	5.0
Reduced water wastage	7	3.2
Affordable	56	25.6
When it fails there is a tanker to provide alternative service	9	4.11
Total	219	100.0

In several nations in the district (Lesotho, Zambia, Malawi, Mozambique, Kenya and Ethiopia) collecting water takes longer than 30 minutes for more than a fourth of the populace. This extensively lessens the time accessible for different exercises, for example, childcare, income age and school participation. (UNCEIF Report, 2010),

It can therefore be assumed from the findings that the innovation have greatly helped reduce the amount of time used to fetch water by making the commodity easily accessible as reported by 23% of the respondents.

Figure 18: Water Access Without Cash



4.4.3 Loss of Card/Token

One of the challenges of having physical items was the possibility of loss or misplacement. The findings from this study showed that 18% of the respondents had lost their cards before with 84.6% of the respondents having lost it only once as shown on the two charts below.

Figure 19: Lost Card Before

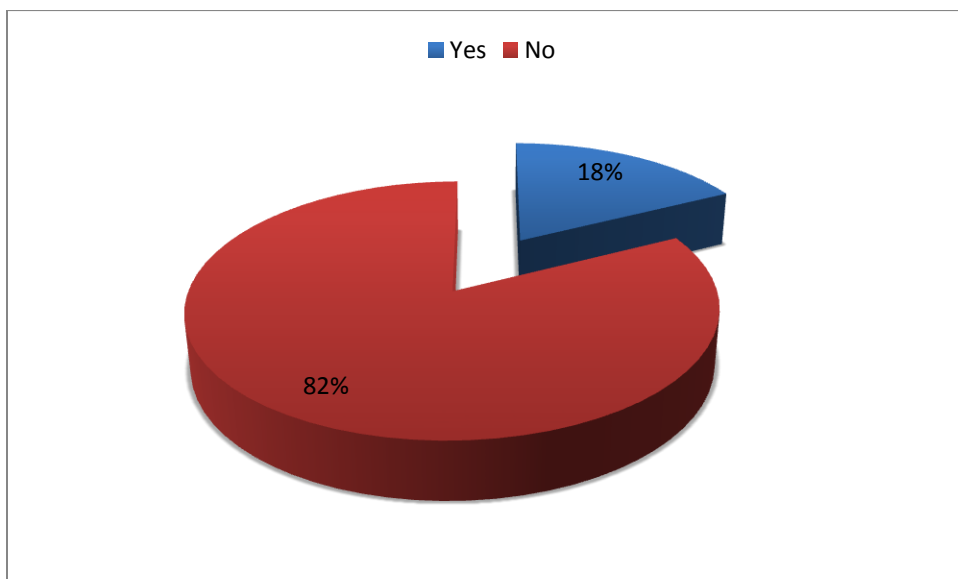
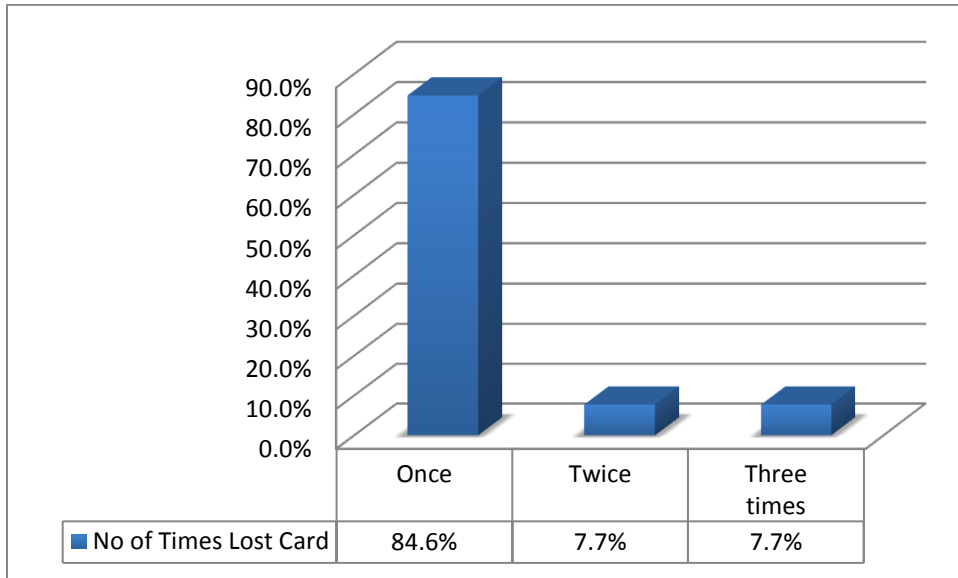
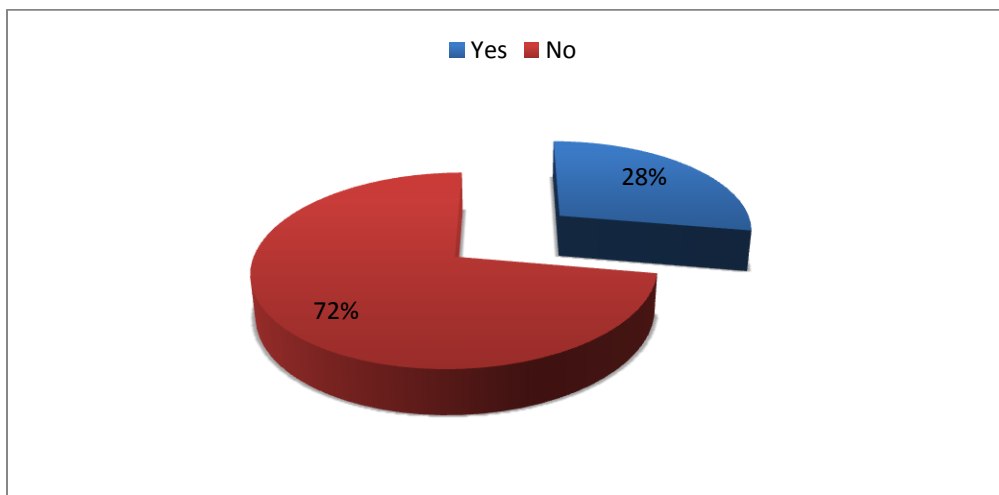


Figure 20: Amount of Times Card Lost



Water was vital to human life therefore the ease of getting a replacement Prepaid Token/ATM card ought to be seamless. As stated earlier in this study without the cards and credit in the PPDs the community members could not access water. The findings from this study showed that the majority 72% experienced challenges when replacing the prepaid token/water ATM card.

Figure 21: Ease of Replacing Prepaid Token Card



When one resident who had lost his token a few weeks earlier asked about the ease of card replacement retorted;

“There was a slow response from Nairobi water in replacing lost cards/tokens, my token got lost with 300 shillings which they have assured me will be topped-up in the new token but it’s been weeks now and I still don’t have a token, it can get frustrating having to borrow one from my neighbours and at times buying water from the water vendors which is more expensive”.

From the sentiments of the respondents the researcher sought a response from Project officers from the company concerning the matter;

“as with any new technology there are hitches that are unforeseen, replacement of the tokens has being a major hurdle in the project, as the company relies on suppliers who do not always honour their promises and take too long to deliver, Mathare especially being the first place the project was piloted experienced a lot of delays, however the company is currently ensuring that tokens/ATM cards in store are more to cater for new customers and replacements”.

4.5 Convenience and Ease of Use

The findings from this study confidently showed that water was available and accessible. But did it meet all the domestic needs? The findings showed that an overwhelming majority of 94% had all their domestic needs met with the current amount of water as shown on figure 28. Furthermore, 98.6% of the respondents found it easy to use the water machines as shown by figure 29 below. However, the few who experienced challenges cited lack of water, congestion and disability unfriendliness as the main obstacles to using the water machines according to the findings.

Figure 22: Water Meeting All Domestic Needs

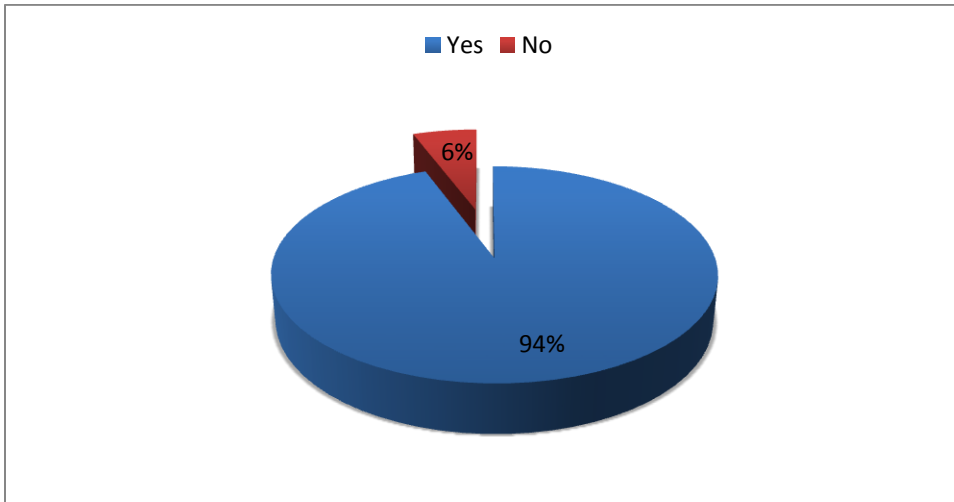
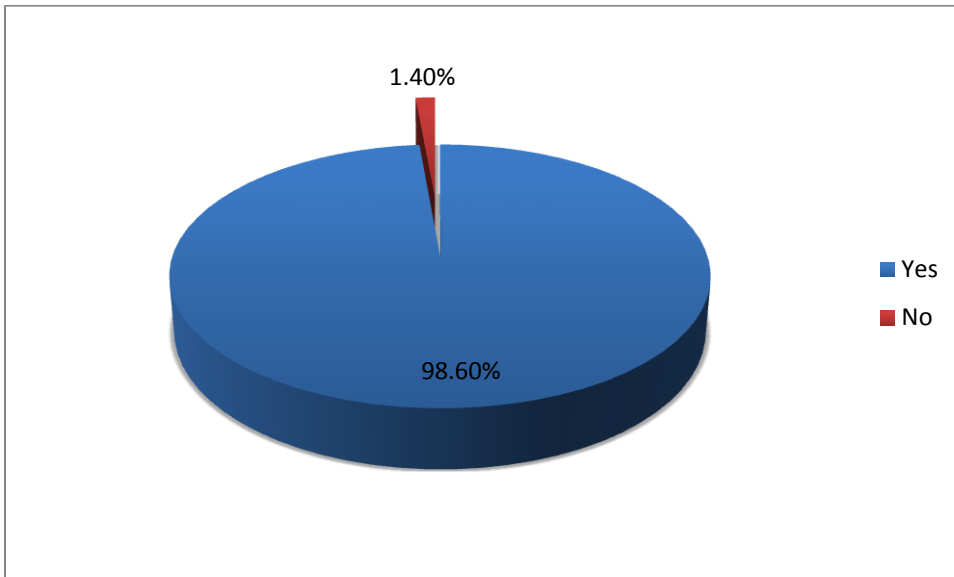


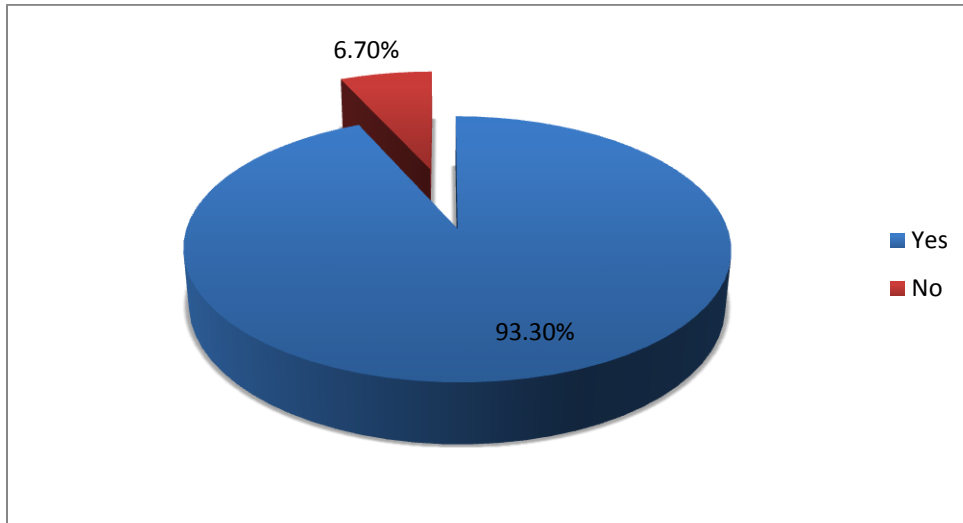
Figure 23: Ease of Use of Water Machine



4.5.1 Convenience

The findings showed that majority (63.6%) of the respondents paid for the services through prepaid tokens/cards. In addition, all of the respondents felt that it was convenient to pay for the services the innovative technologies – using prepaid tokens/cards and 93.3% had found that it was convenient to use the cards/tokens.

Figure 24: Convenient to use Card/Token



4.6 Summary

The findings from this chapter showed that the introduction of the water technology in these two study sites had made water accessible, available and convenient. In addition, the respondents who found the service affordable preferred paying for it through the use of tokens/cards. To further show that the service was affordable, 46 out 50 unemployed respondents, agreed that the service was affordable.

The guardian newspaper run a story about the convenience of water ATMs in Mathare and interviewed a few residents who further showed how this new technology has impacted their life positively.

(The Guardian, Tuesday 16 February 2016 10.04 GMT)

Neighborhood water merchants are not content with natural product dealer Mercy Muiruri. Toward the finish of a year ago, she found an alternate answer for washing organic products previously making them into a serving of mixed greens for her clients – a water ATM. "Presently I know the water I utilize is sheltered and from a confided in source. Indeed, even my clients will be glad," she says. Muiruri has been operating sustenance businesses in one of Kenya's most crowded ghettos, Mathare, for about two decades. As of not long ago, she utilized water from nearby sellers at whatever point she required it.

"Be that as it may, I couldn't vouch for its wellbeing. I, in the same way as other of my companions, never knew the wellspring of that water. It got to us in 20-liter plastic containers and we utilized it," she says.

Presently she and other ghetto occupants have something to grin about. A year ago an open private association between Nairobi Water and Sewerage Company, the city's main water circulation organization, and Grundfos, a Danish water engineering firm, brought about the installation of water vending machines. The machines are relied upon to reform water accessibility and conveyance to populaces that have for quite some time been helpless before water cartels and a changing and temperamental atmosphere.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter discusses the research findings and draws conclusions from those findings. The chapter also makes recommendations on the basis of the conclusions.

5.2 Summary

The overall purpose of this study was to find out how communities in low income areas perceive the new technologies being introduced in water provision. From the findings it can be concluded that the prepaid water solutions have been embraced by the residents in the informal settlements mostly because of the ease of use, data that was availed by the company to the researcher showed that most of the customers of the solutions loaded at least 50Kshs in their tokens/ATM cards which they used for a period of time before reloading again, this led the researcher to conclude that the residents often had a budget for water which meant that they could allocate their earnings and rest easy for a while knowing that they could access water even on days they did not have physical cash. This is makes these solutions very convenient. From the findings 68% of the respondents had used the technology for one year.

Pricing of water in low income areas has been very un-regulated and the residents have been at the mercies of water vendors who are mostly illegal and who also at times control supply to create false demand and ultimately the prices. From the findings of the research discussions from the FDGs clearly brought out this issue and all residents agreed that the regulated water prices was the best way to weed out water cartels, also 97% of the respondents were aware of the 50cents per 20 litre jerrican sold through the prepaid water solutions.

Convenience and ease of use is an important way to measure how effective and efficient a new technology is, it can also be used to gauge if the new technology will be sustainable as it shows it's the rate acceptability. From the research 93% of the respondents reported that they preferred paying for water using the ATM cards and tokens as it was a more convenient way and they could plan ahead and deposit money in their tokens which they could use for a period of time.

5.3 Conclusions

The researcher concluded that residents in the informal settlements are ready and willing to embrace new technologies in service provision and more so for basic and important services such as water, since water has no alternative to it. Informal settlements have for a long time been exploited by water cartels and vendors who have been selling water to them at very exorbitant prices and also controlling the times the water is available.

Water conflict has also been experienced especially where the residents have had to fight to access the commodity in cases of low supply, time spent fetching water and distances covered have also posed great challenges more so to women, elderly, children and the disabled.

From the research it can therefore be concluded that any innovative ways that would ease the burden of accessing water, control and regulate the prices, ensure quality and reliability is welcomed and would be embraced by the residents.

5.4 Recommendations

1. There is need for NCWSC and partner organizations to come up with a policy for prepaid water solutions to guide on how the project will be implemented across all the informal settlements in Nairobi.
2. There is need for NCWSC to ensure that there is constant and reliable supply of water to ensure that the water dispensers work without any hitches.
3. NCWSC to work closely with all stakeholders, community, water vendors/cartels, county government, development organizations working within the informal settlements.

4. NCWSC to come with ways in which to make sure that there is fair distribution of water dispensers within the informal areas and also make it possible for the residents to have token without having to go through unnecessary bureaucratic processes.
5. Community engagement and sensitization should be at the core of ensuring there is a steady uptake of tokens and the communities have the correct information to reduce chances of misleading information.

5.5 Areas for further research.

The scope of the work was limited to two informal settlements and also to only two versions of water technologies, water ATM and Prepaid Token dispenser. In the wake of new technologies in water provision it is important that further research is undertaken to provide areas for more well researched innovations and provide people oriented solutions.

REFERENCES

- African Population and Health Research Center (APHRC) (2014) 'Population and Health Dynamics in Nairobi's Informal Settlements: Report of the Nairobi Cross-Sectional Slums Survey (NCSS) 2012', (April), pp. 1–185.
- Ahiablame, L., Engel, B. and Venort, T. (2012) 'Improving Water Supply Systems for Domestic Uses in Urban Togo: The Case of a Suburb in Lomé', pp. 123–134. doi: 10.3390/w4010123.
- Ajzen, I. (2011) 'The theory of planned behaviour: reactions and reflections.', *Psychology & health*, 26(9), pp. 1113–27. doi: 10.1080/08870446.2011.613995.
- Al-Bader, S., Frew, S. E., Essajee, I., Liu, V. Y., Daar, A. S. and Singer, P. A. (2009) 'Small but tenacious: South Africa's health biotech sector.', *Nature biotechnology*, 27(5), pp. 427–445. doi: 10.1038/nbt0509-427.
- Analysis, S. and Investments, W. R. (2011) 'Towards a Strategic Analysis of Water Resources Investments in Kenya'.
- Analysis, U. G. and The, D. (2012) 'UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water The challenge of extending and sustaining services'.
- Baud, I., Post, J. and Furedy, C. (2016) *Solid Waste Management and Recycling; Actors, Partnerships and Policies in Hyderabad, India and Nairobi, Kenya, The Geo Journal Library*. doi: 10.1007/1-4020-2529-7_11.
- Breslin, N. (2013) 'Changing relationships : ICT to improve water governance', pp. 1–17.
- Carlos, L., Soares, R., Griesinger, M. O., Dachs, J. N. W., Bittner, M. A. and Tavares, S. (2002) 'Inequities in access to and use of drinking water services in Latin America and the Caribbean', 11(1), pp. 386–396.
- Classification, N. E., Dams, O. F., Needed, I. S., Characterize, T. O., The, H. O. W., Variation, T., The, I. N., Mode, O., Dams, O. F., River, I. N. A., Influences, B., Potential, T. H. E., Restoring, F. O. R., Rivers, R. and Dam, V. I. A. (2002) 'How Dams Vary and Why It Matters for the Emerging Science of Dam Removal', pp. 52(8).

Corburn, J. and Karanja, I. (2015) 'Informal settlements and a relational view of health in Nairobi , Kenya : sanitation , gender and dignity Informal settlements and a relational view of health in Nairobi , Kenya : sanitation , gender and dignity', (February). doi: 10.1093/heapro/dau100.

Division, P. (2007) 'Water , Sanitation and Hygiene Annual Report'.

Document, A. R., Planners, F. O. R. and Staff, P. (2003) 'Linking technology choice with operation and maintenance in the context of community water supply'.

Ecosystems, A. N., To, A., Resources, W., For, M. and Cities, A. (no date) *GREEN HILLS , BLUE CITIES*.

Ezugwu, C. N. (2015) 'New Approaches to Solid Waste Management', II, pp. 21–26.

Gleick, P. H. (2015) 'Dirty Water : Estimated Deaths from Water-Related Diseases 2000-2020', pp. 1–12.

Hargreaves, T. (2011) 'Practice-ing behaviour change: Applying social practice theory to pro-environmental behaviour change', *Journal of Consumer Culture*, 11(1), pp. 79–99. doi: 10.1177/1469540510390500.

Henry, R. K., Yongsheng, Z. and Jun, D. (2006) 'Municipal solid waste management challenges in developing countries - Kenyan case study', *Waste Management*, 26(1), pp. 92–100. doi: 10.1016/j.wasman.2005.03.007.

(Iea), I. O. E. A. (2007) *A rapid assessment of kenya' kenya ' s water, sanitation and sewerage framework*.

Imran, M. (2014) 'Impact of Technological Advancement on Employee Performance in Banking Sector', 4(1), pp. 57–70. doi: 10.5296/ijhrs.v4i1.5229.

International, A. (2009) 'Kenya the Unseen Majority : Nairobi.

Irrigation, R. of K. M. of W. and (2007) 'The National Water Services Strategy (NWSS) 2007-2015. Draft.', *Human Rights*, (June 2007).

Issues, K. (no date) 'Water Governance for Poverty Reduction'.

Ivers, N. M., Tu, K., Francis, J., Barnsley, J., Shah, B., Upshur, R., Kiss, A., Grimshaw, J. M. and Zwarenstein, M. (2010) 'Feedback GAP: study protocol for a cluster-randomized trial of goal setting and action plans to increase the effectiveness of audit and feedback interventions in primary care.', *Implementation science : IS*. BioMed Central Ltd, 5(1), p. 98. doi: 10.1186/1748-5908-5-98.

Kinyanjui, M. W. and Wanyoike, D. M. (2016) 'ASSESSMENT OF FACTORS INFLUENCING SUSTAINABILITY OF PERIURBAN WATER SUPPLY PROJECTS', IV(5), pp. 814–837.

Kluger, A. N. and Denisi, A. (1996) 'The Effects of Feedback Interventions on Performance : A Historical Review , a Meta-Analysis , and a Preliminary Feedback Intervention Theory', II(2), pp. 254–284.

Knabe, A. (2012) 'Applying Ajzen's Theory of Planned Behavior to a Study of Online Course Adoption in Public Relations Education'.

Lee, Y., Kozar, K. A. and Larsen, K. R. T. (2003) 'The Technology Acceptance Model : Past , Present , and Future', 12(1).

Lucas, N. L. (no date) 'WATER SERVICES DELIVERY IN MUKONDENI VILLAGE IN LIMPOPO'.

Macro, K. N. B. of S. (Knbs) and I. (2010) 'Kenya Demographic and Health Survey 2008-09', *Health (San Francisco)*, pp. 1–314.

Malenya, K. M., Malenya, K. M. and Omwenga, J. (no date) 'DETERMINANTS OF EFFECTIVE SOLID WASTE MANAGEMENT IN KAKAMEGA COUNTY Student , Jomo Kenyatta University of Agriculture & Technology (JKUAT), Kenya Lecturer , Jomo Kenyatta University of Agriculture & Technology (JKUAT), Kenya Accepted : November 10 , 2'.

Mansuri, G., Rao, V., Chase, R., Gupta, M. Das, Feder, G., Galasso, E., Mclean, K., Owen, D., Ozler, B., Platteau, J., Pradhan, M., Ravallion, M., Ribot, J., Warren, D.,

White, H. and Woolcock, M. (2003) 'Evaluating Community-Based and Community-Driven Development : A Critical Review of the Evidence'. Mason, L. R. (2012) 'Gender and Asset Dimensions of Seasonal Water Insecurity in Urban Philippines', (11).

Mckenzie, D. (1818) 'URBAN WATER SUPPLY IN INDIA : STATUS , REFORM OPTIONS AND POSSIBLE LESSONS'.

Muller, M. (2008) 'Free basic water – a sustainable instrument for a sustainable future in South Africa', 20(1994), pp. 67–87. doi: 10.1177/0956247808089149.

Nations, U. (2006) *Human Development Report 2006*.

Njoroge, K. S., Wokabi, M. S., Ngetich, K. and Kathuri, M. N. (2013) 'Influence of Informal Solid Waste Management on Livelihoods of Urban Solid Waste Collectors : A Case Study of Nakuru Municipality', *International Journal of Humanities and Social Science*, 3(13), pp. 95–108.

Obiti, J. M. (2013) *Kenya Economic Report 2013*. Available at: <http://www.kippra.org/downloads/Kenya Economic Report 2013.pdf>.

Of, A., Challenges, T. H. E., Water, O. F., Residential, S., Of, D., Estate, H., County, N., Kahariri, B. Y., Maina, M., Fulfillment, P., Degree, B. and Planning, E. (2014) 'No Title'.

Oracle, A. and Paper, W. (2011) 'Cross-Channel Commerce : A Consumer Research Study', (March).

Plan, C. (2008) 'Progress Assessment', *Water Supply*, pp. 41–66.

Poverty, E. E., Universal, A., Education, P., Equality, P. G., Women, E., Mortality, R. C., Environmental, E. and Health, I. M. (2015) 'Socio-economic Impacts of Water Supply and Sanitation Projects I. Background 1.', pp. 1–10.

Reduction, P., Annual, S. and Report, P. (2007) 'Kenya : Poverty Reduction Strategy Annual Progress Report — 2003 / 2004 International Monetary Fund Washington , D . C .', (7).

Report, B. (2007) 'UNITED NATIONS DEVELOPMENT PROGRAMME (UNDP), KENYA & UNDP WATER GOVERNANCE FACILITY (WGF) IMPROVING WATER GOVERNANCE IN KENYA THROUGH THE RIGHTS-BASED APPROACH A Mapping and Baseline Report', 44779857(November)Report, S., Application, T. and Approaches, I. (2012) *Water Resources Management*.

'REPUBLIC OF KENYA Ministry of Water and Irrigation The National Water Services Strategy (NWSS)' (2015), (September 2007), pp. 1–38.

Rights, H. (2008) 'RAPID ASSESSMENT OF THE WATER AND SANITATION SITUATION WITHIN INFORMAL', (March), pp. 1–25.

Saba, M. (2005) 'Livelihoods and Gender in Sanitation Hygiene Water Services among Urban poor', (March).

Schemes, W. S. (2008) 'The Sustainability of', (March).

Squires, C. O. and Squires, C. O. (2006) 'Public Participation in Solid Waste Management in Small Island Developing States', (October).

Strobl, E. and Strobl, E. (2008) 'The Economic Growth Impact of Hurricanes : Evidence from US Coastal Counties', (3619).

'Sustainability of Water Services delivery in Urban Poor Settlements: A case of the Ndeeba- Kisenyi pre-paid water services pilot project-Kampala Aharikundira, M' (no date).

Tchobanoglus, G. (2003) 'The importance os decentralized wastewater management in the twenty-first century'.

Trust, M. S., Planning, R. and Planning, R. (2012) 'Collaborative Plan for Informal Settlement Upgrading Mathare Zonal Plan | Nairobi , Kenya Executive Summary', (July).

Undp (2013) 'User's Guide on Assessing Water Governance', pp. 1–116.

United Nations Environment and Programme (2005) *Olid waste management*.

‘Water and sanitation : the economic case for global action’ (2008).

Who and Unicef (2012) *Progress on Drinking Water and Sanitation, Update*. doi: 978-924-1503279.

Yin, R. K. (1994) ‘Case Study Research: Design and Methods’, *Applied Social Research Methods Series*, 5, p. 219. doi: 10.1097/FCH.0b013e31822dda9e.

Zare, F. K., Branch, C. T. and Branch, C. T. (2016) ‘Role of in-service Training and Information Management with SAMAT Public Relations Practitioners Media Literacy Acquaintance’, 3(8), pp.

ANNEXES

ANNEX 1: FOCUS GROUP DISCUSSION TOPIC GUIDE

Serial number of Focus Group Discussion

--	--	--	--	--

Site number

--	--	--

CONSENT FORM

Hello Sir/ Madam,

My name is Priscillah Njoki a postgraduate student at the department of Sociology and Social Work at the University of Nairobi. I am conducting a study from my MA project entitled; **Exploring community perceptions towards innovative water technologies in low income areas in Nairobi.**

You have been chosen haphazardly and we wish, with your authorization, to interview you. A portion of the inquiries solicited, are from a delicate nature, yet please take note of that your name won't be recorded in the survey, and any subtle elements identified with your security will be kept private. Any individual information about you, (for example, your name) won't be utilized and won't be unveiled to anybody. Instead, you will be doled out a number and this will be utilized as a part of place of your name. Your support in this review is essential and we depend on you to furnish us with precise information that will help us to create compelling exercises towards water arrangement in low-income regions.

There are no dangers related with your support in this investigation. Be that as it may, we feel that your investment will contribute incredibly in knowing how best to address challenges.

The interview will take roughly 30-45 minutes, however with your collaboration, it should be possible rapidly.

May I have your permission to undertake this interview? Yes No

If you do not want to participate,
 why.....

Name and signature of the interviewer that a verbal consent was obtained:

Name of interviewer

_____ /2017

Signature of the interviewer

Date (dd/mm/yyyy)

Inclusion Criteria

The participants in the FGDs will include all the community leaders and KOL from Mathare and Kahawa informal settlements and currently being served by the water ATMs and the prepaid meters.

Date of discussion:	Interviewer:	
Venue:	Note taker:	
Time start:	District:	
Time stop:	Interviewee's code:	
Interview completed	Yes	
	No	

Reason for Incomplete interview	

Affordability

1. How long have you used the water? What were you using before?
2. Do you think the water supplied by the NCWSC is cheap? Why

Probe: How much were you paying for water before the introduction of the tokens/smart cards?

Which mode of payment do you prefer to pay for the water? In what ways?

3. How do you pay for the water services? Are you able to access water on credit? Why would you want to access water without money?

Do you think water is cheaper with the new technologies? In what ways?

Accessibility

1. Do you feel that the new water facilities are physically accessible? Do you travel for long to draw the water? How long do you travel? Does distance affect the amount of water you draw? **Probe** How? Please elaborate
2. Do you think the water is sufficient in these water points? Have the water facilities improved the access to water?
3. How much time do you spend at the watering point? Has the technology increased the time you spend drawing water? **Probe** How?
4. Are you in a position to access water without the tokens/smart card? What would you prefer?

Do you still pay for the water services through cash? What if you don't have cash? Do you still access the same amount of water?

5. How did you acquire the smart card/token? Do you think the cards should be sold? Why?
6. How easy is it to reload the smart cards or buy the tokens? What would you want?
7. What challenges have you experienced in these watering facilities? Please list.

Availability and Usability

1. Do you feel that the water you receive from the watering points are in sufficient quantities? Why do think so?
2. Do you feel the introduction of the innovative technologies have affected your usage of the waters? In what ways? Do you still get the same amounts of water compared to before?
3. Do you feel the watering points and the watering holes are adequate to serve the communities? Do you feel that the technologies have improved the delivery of water services? In what ways?
4. What do you feel about the usability of the innovative technologies? Are they user friendly? If misplaced are you able to share with a neighbour? Do you the project will improve the water services delivery in the informal settlements? In what ways?
5. Finally, how easy has it been in implementing the innovative technologies within the communities?

ANNEX II: PARTICIPANTS QUESTIONNAIRE

RESPONDENTS INFORMATION AND CONSENT FROM

Exploring Community Perceptions towards Innovative Water Technologies in Low Income Areas In Nairobi

Serial number of questionnaire

|_|_|_|_|

Site number

|_|_|

CONSENT FORM

Hello Sir/ Madam,

My name is Priscillah Njoki a postgraduate student at the department of Sociology and Social Work at the University of Nairobi. I am conducting a study from my MA project entitled; **Exploring community perceptions towards innovative water technologies in low income areas in Nairobi.**

You have been chosen haphazardly and we wish, with your consent, to interview you. A portion of the inquiries solicited, are from a touchy nature, yet please take note of that your name won't be recorded in the poll, and any points of interest identified with your protection will be kept secret. Any individual information about you, (for example, your name) won't be utilized and won't be revealed to anybody. Instead, you will be allotted a number and this will be utilized as a part of place of your name. Your support in this review is critical and we depend on you to give us exact information that will help us to create compelling exercises towards water arrangement in low income regions.

There are no dangers related with your interest in this investigation. Nonetheless, we feel that your cooperation will contribute extraordinarily in knowing how best to address challenges.

The interview will take roughly 30-45 minutes, yet with your participation it should be possible rapidly.

May I have your permission to undertake this interview? Yes No

If you do not want to participate,
why.....

Name and signature of the interviewer that a verbal consent was obtained:

Name of interviewer

_____ /2017

Signature of the interviewer

Date (dd/mm/yyyy)

A) BIO DATA AND SOCIO DEMOGRAPHIC FACTORS

1. How old are you? (Exact years)
2. Home area/Residence
 1. Mathare
 2. Kahawa Soweto
3. What is your marital status
 1. Married
 2. Single
 3. Divorced/separated
 4. Widowed
 5. Other
4. Level of education

- 1. None
- 2. Primary
- 3. Secondary
- 4. College/university
- 5. Religious status
 - 1. Christian
 - 2. Muslim
 - 3. Other
- 6. Do you have a regular wage/salary?
 - 1. Yes
 - 2. No
- 7. What is your occupation?.....
- 8. What is your main source of income?
 - 1. Employed
 - 2. Self employed
 - 3. Unemployed
 - 4. Housewife`
- 9. How much do you earn per month?.....
- 10. Do you have other sources of income?
 - 1. Yes
 - 2. No
- 11. If yes, which ones?

Source	Income
i)	
ii)	
iii)	
iv)	

B) AFFORDABILITY

12. Are you a direct user of the Prepaid Dispenser or ATM card?

1. Yes 2. No

13. If yes, for how long?.....

14. If no, why have not registered?.....

15. Do you know the water rate charged at the water ATM or prepaid dispenser?

1. Yes 2. No

16. How much are you charged for water at the water ATMs or Prepaid Dispensers?

50cents 1-2shs 2-5shs 5shs

17. In your opinion, is water offered at the water ATMs and Prepaid Dispensers affordable?

1. Yes 2. No

18. How do you pay for the water services?

- 1. Mpesa, Mobile phone money transfer
- 2. Cash
- 3. On Credit
- 4. Prepaid Tokens/Prepaid ATM card
- 5. Other

19. How do you find the new technology? Good Not so good

20. Do you find the new technology convenient?

1. Yes

21. If no why.....

22. Has water become cheap since you started using the water ATMs or Prepaid dispenser? 1. Yes 2. No

23. Who's token/ card are you using?

- 1. Self/Own
- 2. Borrowed
- 3. Leased
- 4. Other

C) ACCESSIBILITY

24. In your opinion are the PPDs or water ATMs located nearby? 1. Yes

2. No

25. Is water from the water ATMs/PPDs available all the time 1. Yes 2. No

26. Is water easily accessible from the ATMs/PPDs 1. Yes 2. No

27. If No, why?.....

28. In your opinion, has the technology hindered or facilitated use of water?

1. Facilitated 2. Hindered

29. If it has hindered how?

.....

30. If it has facilitated how?

.....

31. Are you able to access water without cash 1. Yes 2.No

32. Have you ever lost your card/token? 1. Yes 2. No

33. How many times have you lost it?

.....

34. Was it easy get a replacement 1. Yes 2. No

D) AVAILABILITY AND USABILITY

35. In your opinion, is the amount of water you access through the ATMs/PPDs enough for your domestic needs? 1. Yes

2. No

36. Is it easy use the water machines?

1. Yes

2. No

37. If no what are the major

obstacles?.....

38. Is it convenient to pay for the water using the tokens/cards? 1. Yes 2. No

39. Are the cards/tokens convenient to use?

1. Yes

2. No

(send children, used by the elderly)

ANNEX III: CONSENT FORM

Exploring Community Perceptions towards Innovative Water Technologies in Low Income Areas In Nairobi

Serial number of questionnaire

Site number

CONSENT FORM

Hello Sir/ Madam,

My name is Priscillah Njoki a postgraduate student at the department of Sociology and Social Work at the University of Nairobi. I am conducting a study from my MA project entitled; **Exploring community perceptions towards innovative water technologies in low income areas in Nairobi.**

You have been chosen arbitrarily and we wish, with your authorization, to interview you. A portion of the inquiries solicited, are from a touchy nature, however please take note of that your name won't be recorded in the poll, and any subtle elements identified with your security will be kept classified. Any individual information about you, (for example, your name) won't be utilized and won't be revealed to anybody. Instead, you will be relegated a number and this will be utilized as a part of place of your name. Your interest in this overview is critical and we depend on you to furnish us with precise information that will help us to create compelling exercises towards water arrangement in low income zones.

There are no risks related with your collaboration in this examination. In any case, we feel that your interest will contribute altogether in knowing how best to address challenges.

The interview will take around 30-45 minutes, yet with your participation it should be possible rapidly.

May I have your permission to undertake this interview? Yes No

If you do not want to participate,
why.....

Name and signature of the interviewer that a verbal consent was obtained:

Name of interviewer

_____ /2017

Signature of the interviewer

Date (dd/mm/yyyy)