

**FACTORS INFLUENCING WATER SERVICE PROVISION IN KENYA: A
CASE OF NAIROBI CITY WATER AND SEWERAGE COMPANY**

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DECLARATION

This research project report is my original and has never been presented to any university for any award.

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This research project report has been submitted for examination with my approval as the university supervisor.

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DEDICATION

I dedicate this work to my loving wife Jane Wangare ,Sons Lenny Allan, RJ and my daughter Lynn Alma for their support and patience during the time of writing this project.

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ABBREVIATIONS AND ACRONYMS

EPA	: Environmental Protection Agent
GoK	: Government of Kenya
IWM	: Integrated Water Management
KIWASCO	: Kisumu Water and Sewerage Company
KNBS	: Kenya National Bureau of Statistics
MDGs	: Millennium Development Goals
MWI	: Ministry of Water and Irrigation
NCWSC	: Nairobi City Water Sewerage Company
NRW	: Non-Revenue Water
NWCPC	: National Water Conservation and Pipeline Corporation
SPA	: Service Provisions Agreement
SPSS	: Statistical Package for Social Sciences
UNICEF	: United Nations Children’s Fund
WASREB	: Water Services and Regulatory Board
WatSan	: Water and Sanitation
WHO	: World Health Organization
WRMA	: Water Resources Management Authority
WSB	: Water Services Boards
WSPs	: Water Services Providers

ABSTRACT

The study investigated factors that influence water service provision in Nairobi County. The purpose of this study was to investigate the underlying factors that influence water service provision in Kenya, Nairobi County. The objectives of the study were to determine how water sources influence water service provision in Nairobi County, to establish how water management influence water service provision in Nairobi County, to determine how the existing water supply infrastructure influences water service provision in Nairobi County and lastly to assess how environmental factor influences water service provision in Nairobi County. The research design used was descriptive survey research design. The target population was the staff working in Technical Directorate and specifically those in production and distribution departments. A sample size of 267 staff members from the company was selected. The study used stratified random sampling techniques due to the nature of the population studied. The two departments have a population of 877 staff. To achieve the objectives, the study used primary data in the form of questionnaires, and secondary data from literatures, articles, books and internet sources. The collected data was analyzed using package for social science. The study established that there are various sources of water in the Nairobi County including dams, rainwater, boreholes, runoff the river, weir intakes and springs. However, water treated at the production plants is sufficient to only 68% of the customers in the Nairobi County. The study found that increase in water sources, efficient water management and improved water supply infrastructure would lead to increase in water services provision while good environmental conditions has a positive relationship with water services provision. The study concludes that deteriorating infrastructure, poor maintenance, lack of new investments, unstable funding in the sector increases pollution of water resources, unclear legislative framework for managing water and lack of sector policy on water resources management lead to poor water service provision in Nairobi Water. The study recommends that the government should consider increase the water sources, clarity in resources management, increase infrastructure investments in water provision, care of the changing environment in order to continually improve water service provision to enable the Nairobi County to offer sustainable access to safe drinking water and basic sanitation to its residents and Kenyan at large.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

It is reported that over one Billion people in the World have no access to a reliable source of clean, freshwater on daily basis. Globally, water provision has not been adequate and this have raise concerns government and nongovernmental organizations. Bandaragoda (2006) indicated that access to quality water for all in Asia has over times regenerated the great interest through the declaration of the Millennium Development Goals (MDG) with specific targets to reducing by half the proportion of persons with no access to safe quality drinking water by 2015 (United Nations 2000). Samad (2005) posited that macro level institutional changes on water sector reforms success in Sri Lanka. Investment packages at macro level institutional on water sector policies are low and that there is need to attach certain element, which are politically unpalatable, as covenants in a package of investments as that would unlikely generate the desired results for forging ahead with Sri Lanka's water sector reforms.

Lack of universal access to safe water and sanitation results in over a million preventable deaths each year. Nearly 10% of the total burden of disease worldwide is attributable to poor quality unsafe water, poor sanitation and other basic hygiene diseases claiming over 3.6 Million deaths lives annually (Pruss, 2008). The issues of access to quality improved water and sanitation conditions is of great importance and forms the basis for a healthy community that in turn results to a great significant health nation, economic social vibrant gains (Mihelcic , 2003).

Within the African Continent about 300 million persons do not have access to safe quality drinking water and about 313 Million people lack access to sanitation. This makes Africa have the lowest area of water supply in terms of coverage as compared to the other World Continents (ADF, 2005). Gordon, Hays, Pollack, Sanchez, and Walsh (2011) indicate that water is essential for all life. Apart from the water that we drink, water is used for food growth, power generation, the construction industry, and more in the production process that produce goods for consumption and trade. The ecosystem fully requires water to continue to serve as the key foundation of any Country's economy and people's way of life. It's however much notable that water scarcity is increasingly becoming a critical challenge.

The world's population has over time seen tremendous increase, whereas the water as a renewable resource is rapidly reducing as the gap between the supply and demand widens. This has been made worse by the increased urbanization and the most recent climate changes complicating it even more. It is worth to note that safe drinking water is required for life Environmental Protection Agent (EPA, 2009). For the Millennium Development goals (MDGS) to be achieved the reduction and elimination of poverty is hinged to improved access to quality water and sanitation facilities.

The recognition by the UN General Assembly, in 2010, of water and sanitation as a human right provides additional political impetus towards the ultimate goal of providing everyone with access to these vital services. With this in mind, the United Nations Millennium Development Goals (MDG) aims at halving the proportion of people without sustainable access to safe drinking water and basic sanitation by the year 2015 (WHO, 2010).

UNICEF (2010), stated that the use of improved sources of drinking-water is high globally, with 87% of the world population and 84% of the people in developing nations getting their drinking-water from such sources. Even so, 884 million people in the world still do not get their drinking-water from improved sources, almost all of them in developing regions. Sub-Saharan Africa accounts for over a third of that number, and is lagging behind in progress towards the Millennium Development Goals (MDG) target, with only 60% of the population using improved sources of drinking-water despite an increase of 11 % points since 1990, (JMP Report, 2010).

Agenda 21 provides a general framework for examining sustainability of water and sanitation. The document declares that “sustainability is the integration of environmental and development concerns for the fulfillment of basic needs and improved living standards for all” (UNDP-WSP 2006). Kenya is a water scarce country with per capita availability of 647 m³ of water per annum which is less than the recommended per capita availability of 1000m³ of water per annum. This per capita availability is projected to fall to 235m³ by 2025 (WHO, 1998) as the population increases and could be even less if resource base continues to be degraded. Comparatively, Uganda and Tanzania have 2,940m³ and 2,696m³ respectively (Nat. conference on IWM, 2002).

This means that Kenya cannot afford the luxury that its neighbors have and must treat and manage water as a scarce resource with a social and economic value. Regional water shortages and drought are discussed and featured regularly in the local media. Declining service levels can be linked with a rapidly growing and increasingly impoverished population, under-investment in water facilities and ineffective

financial and commercial management of utilities. Inadequate water supplies have been blamed for hampering socio-economic growth in Kenya and compromising the integrity of national ecosystems. The subject of the provision of sufficiently and adequate water supply to the increasingly growing urban population is a daunting assignment Worldwide (Schuringa, 2006). The constitution of Kenya recognizes provision of water and sanitation services as a basic right provided for articles 43 (1) subsections b and d.

Although the Government of Kenya (GoK) has affirmed its commitment to achievement of the UN (MDGs) to provide water and sanitation as key investment in the Country's long term plans for access to safe, adequate and affordable water and Sanitation (Watsan) services are still an essential and urgent tasks. It is reported that Kenya Watsan overall coverage still fall below the required standard where 53% of the households are still using water from unsafe sources.

The spelling out of the SDGs have more zeroed to specifics that as they are been developed in a consultative process at global, regional and national levels, to actualize this 19 areas of focus have been identified. One of those is subsector specific for water and sanitation. For a water secure world and realization of the right to safe drinking water, some of the key areas considered include; Ensuring access to safe and affordable drinking water, providing adequate facilities and infrastructure, both build and natural for safe drinking water (NCWSC Strategic Plan 2014/15).

Access to water and sanitation services in Kenya for the urban and rural areas remains very poor. These groups have been deprived due to lack of required infrastructure or by neglect. As a natural resource, water has a key role in development and sustainable livelihoods, hence equitable, sustainable and efficient distribution of basic water and sanitation services is crucial (Nallathiga,2006). Some of the main reasons hindering access to safe water include old infrastructure, poor management low maintenance of existing infrastructure and low investments in the sector over time.

From the National Water Master Plan Aftercare Studies (1998) it is reported that about 1800 water supply systems are under the management of various providers. At present the right to safe water and sanitation is enshrined in our 2010 Constitution. This puts pressure to the respective government agencies to deliver their mandate to the citizens'. Based on this, the two levels of government (National and County) have to create an enabling environment for development towards the realization of this right guided by Article 189 of the Constitution. The institutions responsible for the provision of water and sanitation services are expected to deliver the rightful services both effectively and efficiently to ensure progress to achieving right to safe clean water (WASREB 2013/14).

The 2002 Water Act brought reforms in the water sector that were purposed to making the dream of access to clean water and sewerage services come to true to Kenyans. The water sector reforms created the regional water Boards which were tasked with the responsibility of overseeing the planned activities of water and sewerage utilities in their licensed areas and in addition carry out asset developments. Within this structure, NCWSC falls under Athi Water Services Board (AWSB).

The mandate of the Company is to provide clean water and sewerage services to the residents of Nairobi County in a financially sustainable way within the laid Government regulations. At present the City population is estimated to about of 3.8 Million, this is projected to grow over 4.5 million by 2018. By the end of 2015, NCWSC had 280,000 connections, this is projected to increase to 400,000 by 2018/19, (NCWSC strategic Plan 2014/15). The Nairobi County has a measured area of about out 700 km² at the south-eastern end of Kenya's agricultural heartland. The City enjoys tolerable temperatures year round and two distinct rainfall seasons, the long term and the short term rainfall (CBS 2001, Mitullah 2003).

Otieno (2010) conducted studies on access to water in Huruma area and one of his findings was that high water costs was identified as the greatest challenge affecting water access and provisions to Huruma estates residents of within Nairobi. The researcher further listed, leaking water pipes, illegal water, and harassment by administrative authorities as some of the challenges affecting water actors. Whereas this could be a localized problem other County Estates could have different issues. It's based on such facts that the researcher proposes to study other underlying factors influencing water service provision in Nairobi.

1.2 Statement of the Problem

Water service provision in the Nairobi County faces and suffers a number of problems. The City residents and environs still faces frequent and intermittent water shortages even after lots of internal water reforms from the City Council of Nairobi in 2006, and the formation of Nairobi City Water and Sewerage Company Ltd.

The study aims at factors influencing Water service provision by NCWSC. According to 2009 Kenya National Bureau of Statistics (KNBS) population Census 76% of households in Nairobi have piped water though the supply is at times intermittent. The County is faced with excess demand over supply occasioned by rapid population growth as a result of rural urban migration and economic development. The current water supply in the City is 520,000 m³/day and the present demand for water is 720,000 m³/day. This puts the city at a daily water deficit of 200,000 m³/day (Egis, 2015)

Some parts of the City have poor access to clean water due to old dilapidated infrastructure that affects water quality. The locals' dailies Daily Nation 27th Dec, (Mutavi, 2016) reported due to the failure of the short rains in the Aberdare the main sources of water, the NCWSC top management announced the rationing of water in the City supplies. In the year 2016, during the long rains the City experienced heavy rainfall resulting to excessive flooding that led to damages on water, road and housing infrastructure (Apex Africa, 2016). During these times the residents also experienced huge traffic snarl up among other damages occasioned by the flooding of the roads. On the cessation of the rains the taps run dry in the City. This was caused by subsequent poor rainfall performance. Whereas the Nairobi City was on water rationing, some towns had sufficient water supplies (GoK Long Rains Season Assessment Report, August 2016).

The water problem in Nairobi and environs disrupts social and economic activities throughout the Country. It is unfortunate the drought wave and water shortages in Kenya and the horn of East Africa is only expected to continue (Allube, 2011).

The water crisis is not only due to drought wave, but from other aspects like poor management, under investment in infrastructure, rampant deforestation, huge population explosion (Allube, 2011).

1.3 The Purpose of the Study

The purpose of this study was to investigate factors that influence water service provision in Nairobi County.

1.4 Objectives of the study

- i. To determine how water sources influence water service provision in Nairobi County.
- ii. To establish the extent to which water management influence water service provision in Nairobi County.
- iii. To determine extent water supply infrastructure influences water service provision in Nairobi County.
- iv. To assess how environmental factor influences water service provision in Nairobi County.

1.5 Research Questions

- i. How does a water source influence water service provision in Nairobi County?
- ii. To what extent does water management influence water service provision in Nairobi County?
- iii. To what extent does water supply infrastructure influence water service provision in Nairobi County?
- iv. How does the environmental factor influence water service provision in Nairobi County?

1.6 Significance of the Study

The study is timely as it provides insight to factors affecting water service provision in Nairobi County and provides approaches to deal with the current and future challenges. The knowledge therefore provides important information that can be integrated to planning within the organization to improve water service provision. The study provide invaluable information in combating threats on water service provision and ensuring that the Nairobi County gears itself towards attaining Kenya Vision 2030 and MDGs been the business hub for the region. The results of the study goes a long way and be important to researchers and scholars and form basis for further studies

1.7 Limitations of the study

The water production sources for the Nairobi County are sparsely located with some out of the Nairobi County and means of movement while collecting data was affected by vast distances.

The researcher faced time constraint since the study was carried out within short time frame. To overcome time and geographical limitation the researcher hired data collection assistant to help during data collection. Availability of financial resources were limiting the study since the researcher were self-sponsored therefore the researcher come up with a budget for the project to its accomplishment.

The study was also limited in that some management staff in NCWSC expressed some discomfort in giving confidential company information. This challenge was overcome by the researcher engaging the staff in a verbal discussion which that was an opportunity to clarify the intention of the study to the respondents.

1.8 Delimitation of the Study

The study only focused to staff working within the Nairobi City Water and Sewerage Company on their views towards water service provision in the City. The institution is mandated to provide water in Nairobi County. The stations where questionnaire was administered are vast spread. The researcher made a budget available that focused on minimal costs without affecting the quality and the scope of the study.

1.9 Basic Assumption of Study

One assumption of the study was that the staffs working in NCWSC have inherent knowledge of water supply and provision issues were best suited to give information concerning factors influencing water service in Nairobi County. It was also assumed that the sample size chosen was adequate to enable the researcher draw valid conclusion.

1.10 Definition of Significance Terms used in the Study

A number of key words and terms have been used in this project report, which are defined in this study as follows:

Water service provision: This is making the supply of water for domestic and industrial service available in certain geographical area in a planned way.

This can be measured in hours of supply and the quality in volumes within a specific zone.

Water sources: These are areas from where the commodity water is potentially useful or can be harnessed from. They include springs, rivers, boreholes, reservoirs among others.

Water management: These are actions that are scheduled for and carried out to make water as a resource or the commodity available for use; they include planning, budgeting, developing and distributing.

Water supply infrastructure: This is the water circulatory system that holds water, treat and assisting in supplying and distribution of the commodity to the consumer. Some of

such infrastructure includes dam and their sizes, reservoirs, intakes works, embankments, pipes among others

Environmental factor: These are ecological issues that could be biotic or abiotic having influences living organisms and for this case affecting water. Such factors include rainfall intensity, rainfall patterns and drought cycles.

1.11 Organization of the Study

Chapter one of the study deal with the background of the study, statement of the problem, purpose of the study and objectives of the research. It also discusses research questions, significance of the study, assumptions of the study, limitations, delimitations and definition of the significant terms.

Chapter two covers an introduction, theoretical framework, related empirical literature on factors influencing water provision, as well as the conceptual framework. Chapter three contains the following under research methodology: research design, target population, sampling procedure, research instruments, validity and reliability of the instruments, data analysis and ethical issues.

Chapter four present data analysis, presentation and interpretation in relation to the topic studied. Chapter five consist of summary of findings, discussion, conclusions, recommendations and suggestions for further study. This is followed by references and appendices sections.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews the empirical and theoretical literature related to factors influencing water service provision in Nairobi County. The factors investigated included; water sources, water management, water supply infrastructure, and environmental factors.

2.2 The Concept of Water Service Provision

The natural water resources endowment determines the availability of water and the ways it is distributed either equitably or has inequitable distribution of the water services. In addition to the natural availability there are other factors that determine and affect the distribution of water. These include population distribution, and their mobility, community socio- economic status, leadership and political influence real or perceived, costs of water technology and government commitment Water Aid,(2005). Water supply systems provide the variety sources and location from which water is obtained treated and thereafter distributed for use. About 3.5 billion people that have access to piped water receive poor services and majority of this about 80% are in the developing countries where the population lives UNICEF, (2010).

The water provision and supply quality has a number of dimensions the key ones been continuity, water quality itself, pressure and the degree of responsiveness of the agent or the service provider to the customers' issues. The water quality aspect has a micro biological and a physio – chemical elements. A number of parameters of water quality are measured when it comes to water supply. For public water supply systems, the water must meet some minimum aspects like chlorination before use. Water pressures are of different kinds varying from one location of the distribution system to another. Where we have poorly managed systems, water pressure can be low resulting only to water trickle and taken as supply failure. In urban areas, in order to

maintain high water pressures, treated water ready for supply are pumped or directed to water towers making them easily flow via gravity to various distribution points and hence cutting down costs on pumping and reduce distribution failures (Nikson, 2003). Transnational Institute, (2012) enumerates that a number of countries around the world have established legal agencies for water infrastructure that include water and sewer provision services. This is mainly done in order to protect the consumers and improve water supply efficiencies. The entities are expected to be firm and act objectively while regulating the services while even handling customer services. The regulatory agencies are planned to be autonomous from the executive part of the government, but more often they are not able to exercise with great degree of independence. In the United States of America and Canada the regulating agency have existed over 100 years. In England the regulatory for water services was created as part of privatization in the 1990s. In the countries where we do not have regulatory agencies the water service provision is basically regulated by the Local Government or the national government, such countries include China and India.

Water supply service providers commonly referred to as utilities differ from each other in terms of their geographical coverage, administrative boundary, sectorial coverage, ownership structure, organization and their institutional governance arrangements. The Transnational Institute, (2012) continues to express that some water utilities only provide water supply only whereas the sewerage is handled different like the example of Tunisia. However, in most cases the utilities handle both water and sewer services include Kenya.

Water supply providers could be either public or private. It's however observed that most of the water supply services around the world are public facilities. Prince Orange, (2000) states that "water crisis affecting many people are mainly a crisis of governance issues and not water scarcity". This forms a huge subject of debate that has been explored in this research study. It is observed that over 90% of water supply provisions are currently in the public sector. This means that they are owned by the

state or local authorities. They are operated as nonprofit making entity and they are only to provide public common good. This has however led to in-efficiency as a result of political interference resulting to issues like over staffing and low labor productivity. Unfortunately, this has occasioned high costs of water provision to the urban poor and poor access. This has been cited by previous studies in Huruma in Kenya by (Otieno, 2013).

It's worth to note that the issues of demand via sources face huge challenges in most parts of the World. For example in South Africa's water resources are already under huge demand (Maake, 2015). Most the water sources there are already utilized and it is reported that finding other news sources are becoming more difficult over time. South Africa is semi-arid and water resources are limited and used daily at a rapid state. The Country does not receive rainfall distributed all year round, and there is no constant recharge of ground water.

They rely more heavily on use the existing perennial rivers, dams and ground water. There is reported heavy investment in storage of water during the wet seasons for use during the prolonged dry spells. The large dams distributed all over the country capture the high flows that are utilized in many different ways in the economically. For the Kenya case, the Water Act of 2002 gave legal force to the National Water Policy objectives. The key provisions of the Act allowed necessary reforms in management of water resources, strengthening the institutional framework of the water sector while eliminating the role of government in direct service provision and providing mechanisms for financing water resources and services. The Ministry of Water and Irrigation (MWI) was vested with the responsibility for overall sector oversight including policy formulation, coordination and resource mobilization.

Under the Water Act, 2002, water and sewerage services are separated from water resources management to minimize conflicts of interests between allocation and service provision. The Act also established standards for the provision of water and sewerage services. The Water Services Regulatory Authority, Water Services Boards and Water Services Providers are three tiers of institutions established for water and sewerage. The water service providers are licensed by the Water boards and for the case of Nairobi Water it's licensed by Athi Water Services Board to carry out the water service provision.

2.3 Water Sources and Water Services Provisions

In the United states it has been observed that freshwater resources are drawn from surface and ground water sources (Rop, 2013).

Surface water sources account for about three-quarters of withdrawals; in the arid west whereas ground water sources supply a larger percentage of withdrawals in the East. Some of the key factors of selecting water supply sources include adequacy source and reliability of the supply. Without these, the water supply system cannot be considered viable. Adequacy of supply requires that the source be large enough to meet the water demand Water Partnership Program, (2012). An adequate source is one that ensures constant supply of drinking water that satisfies the quantity and quality elements. The source should meet the community need and the regulatory requirements Lee and Bastemeijer, 1991). Sphere Project, (2000) recommends that the first priority of a water utility is to provide an adequate quantity of water, even if its quality is poor, and to protect water sources from contamination. It further states that a minimum of 15 litres per person daily should be provided.

At most of the times dependence on a single source is undesirable, and in some cases, diversification is essential for reliability Water Partnership Program, (2012). Most consumers prefer to use multiple sources of water. Some will prefer certain sources for drinking water and others for laundry, bathing, watering animals and irrigation. In addition to this in order to caution during the times of plenty like floods, enough

chemical stocks are vital to carry out disinfection. This should not only cater for the treatment plants but also direct sources if need arises. Depending on the economic base of the community or neighborhood concerned, extensions could be made for the provision of alternative for livestock, small scaled industries or irrigation use. It is worth to note that drinking water; cooking and personal hygiene is given the high first priority (Meeks, 2012). From the Water Partnership Program, 2012 report as indicated in a 2009 population census and demographic indicators, 38% of urban dwellers receive water from a networked pipe, with 14% having water piped into their dwellings. The figures are significantly higher in towns with better infrastructure like Nairobi. The report also indicates that 24% source their water from springs, boreholes and wells. This is usually the case in urban areas located in arid and semi-arid areas. Water vendors account for 13% water supply to urban households. Rainwater harvesting is still underexploited both in urban and rural areas in the country.

In Kenya, the main water sources include; dams, rain water, boreholes, wells, springs, rivers (mostly seasonal) and streams. Water can be abstracted from these sources after determining the safe yield GoK, water design Manual, (2005). The NCWSC strategic plan seeks to develop of the sources identified above as natural sources sustainably to continually offer water service provision to the City residents.

The studies by KIWASCO (2007) shows that sources, which require little or no treatment of the water, should be prioritized provided that the quantity of water required is available. Springs and ground water sources follow in that order of priority. At localized levels, house hold and small scale community water suppliers rainwater harvesting could serve in most medium and have a high potential areas in Kenya. Surface water from river streams and lakes always require some treatment in order to make it safe for human consumption. It is worth to note that for large water supplies damming is often considered more economical. Rivers which have the bulk of their catchment in forest areas should be preferred for damming as they have lesser

contamination. Sub-surface water drawn from a riverbed or riverbank is viable alternates in dry for water supply provisions.

The report recommends that studies whether a combination of multiple sources could be more or yield more economical and reliable water supply system than single source system. When mixing is done, this is used to cause a higher dilution factor and thus reduces certain constituents like fluoride to acceptable levels.

Gravitational systems are particularly favorable when costs are analyzed NCWSC, (2011). Permanent water-supply arrangements will depend on the type of settlement and the size to be served. When existing water sources have been destroyed, new sources may need to be selected. It has been observed that protect existing sources is however better than develop new sources. Nairobi County obtains its water from the satellite regions that border it and thus does not have its own source of water Howard, (1984). The total combined sources of water as supply to the Nairobi City stand at 520,000m³/day against a demand of 720,000 m³/day Egis et al., (2016). This puts pressure on the existing water sources.

2.4 Water Management and Water Service provision

Different states and government manage the water resources differently. For example, in the US, water supply policies and regulation are usually defined by one or several Ministries, together in consultation with the existing legislative organs. It is noted that in the United States of America, the Environment Protection Agency has an administrator who reports directly to the President and is responsible for water sanitation policies and setting of the standards within the executive, Rop, (2013). A few countries, such as Jordan and Bolivia, have a Ministry of Water where most of the times the Ministries share responsibilities for water supply function.

Some of the key functions of the Ministry include policy and regulatory that is not limited to creation of tariff rules, value, setting guidelines and enforcement rules on quality of service offered and environmental protection. According to Krhoda, (2008) water management in Kenya and Africa at large have been identified as the key inhibitor to water service provisions For the Kenyan case, Moraa, Atieno and Salim, (2012) show that all water resources in Kenya remain vested in the state. The Ministry of Water and Irrigation main function is creating institutions to manage water resources that provide water services.

The Water Resources Management Authority (WRMA) an agency established by the government has responsibilities of water use approval and issuance of water permit. The water permits define the purpose of water use, the approved volumes that are to be abstracted and the length duration of the permit. In addition to this WRMA ensures rational and equitable allocation of National water resources, carry out water quality monitoring, testing and surveillance to ensure that drinking water and effluent discharges meet the required set standards, mapping out and publishing key water catchment areas groundwater resources and flood prone areas (Water Act, 2002). The pricing for each of the tariff is usually done by the specific WSP in consultation with the various stakeholders and thereafter approved by WASREB. This has led to annual scheduled stakeholder meetings by NCWSC as indicated in the impact report by WASREB 2013/14 and the NCWSC strategic plan 2015.

Several water stakeholder forums Onjala (2002) continues to elaborate that, the Ministry of Water and GTZ, decided to create Water and Sewerage Companies (WSCs) as a step towards commercialization.

These WSCs were set up along the normal lines of a private company, with shareholders, a Board of Directors and a corporate management team (the latter consisting of a Managing Director, a Commercial Manager and a Technical Manager). The then municipal council was the sole owner of the company because it owns all shares, thus exercising control over the company (officially through the

annual general meeting). The ultimate authority often lays with the Board of Directors, for it its checks on the overall performance of the company. It also appoints the Managing Director. The Board brings together representatives from the municipality, the state and stakeholders, thus giving it a 'democratic' outlook. Three municipalities were selected to start with: Eldoret, Nyeri and Nakuru. Owuor, et al. (2006) attributes these efforts to the persistent failure and inability of most local authorities in the provision of water supply and sanitation services.

Most local authorities faced, and continued to face, a number of persistent problems in water supply and management that included: frequent water shortages and wastage, high unaccounted-for-water that forms part of the NRW, unauthorized connections, poor management of funds from the billed water, non-functional water meters and nonpayment of water by customers Owour, 2006.

In 1998, the government established the National Water Conservation and Pipeline Corporation (NWCPC) to take over the management of government operated water supply systems that could be run on a commercial basis. In addition, large municipalities were allowed to supply water within their areas. NWCPC failed to attain financial viability or to improve provision of water supply as originally envisaged. Neither could the local authorities do any better.

Due to the number of challenges the Water Service Board have been given the responsibility for overall water and sanitation provision services are in direct hand of the Water Service Boards. It's worth to note that they directly do not offer the service but this is done by delegating to Water service providers (WSP) through regulated by service provision agreements (SPAs) that ensure compliance to quality standards established by WASREB. This was done to overcome the following challenges; lack of a comprehensive sector policy or strategy that would guide the sector and various organizations on their tasks performance, unclear roles and at times duplication of

assignment. This has results in deteriorating infrastructure, poor maintenance, lack of new investments, unstable funding in the sector increases pollution of water resources, unclear legislative framework for managing water, lack of sector policy on water resources management, and lack of stakeholder involvement and ownership by consumers and users.

Management is the process of designing and maintains an environment in which individuals, working together in groups, efficiently accomplish selected organization tasks Kootz et al, (2004). Thus managers have a key role to place appropriate resources and in the right combination to achieve the desired outputs cost effectively in regards to time, budget and scope. According to Krhoda, (2008) low or lack of awareness of the rules governing water services provision is one of the biggest impediment to water service provisions in Kenya and the Sub Saharan Africa.

Managers perform ten basic roles which fall into three categories, information, interpersonal and decisional Mintzberg, (1971). This then lead as to the fact that under management the managers in the water resources sector transmits information to the outside world on behalf of the organization, initiates controlled changes in the organization, deals with unexpected changes by taking corrective action, makes decisions on resources organization, represents the organization during the negotiation with stake holders and defends its interests of the organization. The study attempts to find out how NCWSC production and distribution management staff practices influence water service provision.

Organization differs greatly in size, function and make up. There are three distinct characteristics in all the organizations been division of labor, decision making structure formal rules and policies (Robbins, 1983). Organizations practice labor division both vertically and horizontally. The study finds out how the division of labor at production and distribution levels influences water service provision with NCWSC

operations. The applicability depends on staff experience and expertise. For the success of any organization, the management needs to go extra mile to entrenching total quality management. This as stated by Deming (1986), Ishikawa (1990), by showing attention to continuous improvement of production process and gaining employee commitment to the idea of quality at every production stage. It is however of great importance to achieve consistence high quality standard of finished goods at a price to the customer. For the case of NCSWC quality and reliable water delivery of service is enshrined in the customer charter.

At present the management of the water service provisions to the County is wholly under NCSWC and it's against such background that the researcher establishes to know how the management influences service provisions. It is the expectation of the customers to receive water continually with minimal hours or no interruptions.

2.5 Water Supply Infrastructure and Water Service Provision

Infrastructure refers to structures, systems, and facilities serving the economy of a business, industry, country, city, town, or area, including the services and facilities necessary for its economy function (Steven, 2003). Other studies like Rop ,(2013) identified water supply infrastructure as a circulatory system of a country. More development means that more water is abstracted from the environment, stored, treated, and consumed (UK guide 2006). This is often accompanied by increased wastewater flows as discharges from sewage treatment works, then back to the environment. Increased consumption increases the need for additional Water Supply Infrastructure (WSI). In this context WSI is defined as: licensed systems for abstraction from reservoirs, rivers and aquifers; new storage provision like dams and long distance movement of water between catchments; raw water abstraction and treatment; major transfer pumping stations and pipelines to local areas of demand. In addition to the above any changes further create a need for additional infrastructure to control surface water runoff in urban areas; local drainage, wastewater network, treatment and the receiving watercourses.

Too much of the water infrastructure is outdated, overused and underserviced. Water and wastewater infrastructure in the US is reported to be headed for a crisis. The infrastructure is a relic of post-World War II investment (Gordon, 2011). Deferred maintenance and delayed pipe replacement have a real impact. The decaying water supply infrastructure pollutes waters and wastes natural resources. It is documented by the White Paper, (2013) that water is one of most essential commodities, yet the infrastructure supporting its delivery is not often repaired. Meeks, (2012) states that in developing countries, households without water supply infrastructure spend billions of hours collecting water for domestic use every year. The lack of water supply infrastructure could lead to poor planning and thereby affecting other activities in our homes and impacts on other formal works, agricultural labor and small scale business Blackden and Wodon, (2006). When lacking water at their home, household members must bring water from other sources, either improved (wells, protected springs, shared community stand pipes and taps) or go for the same in unprotected areas like streams, rivers, lakes, and irrigation canals.

The United Nations, (2010) documents that average time required per round-trip to collect drinking water in rural areas is 36 minutes in Sub-Saharan Africa and 23 minutes in Asia. Studies on the labor impacts of water infrastructure have found that access to water facilities may result to less time spent collecting water. Some urban towns like Morocco, random studies reveal that shifting households from free public taps connections results to time gains that are used for other activities like leisure and planned social activities (Devoto et al, 2011). Both gravity flow and pumps are typically used for water transmission and distribution.

Gravity water flow is far efficiency as it reduces dependence on pumps, power supplies, reduces costs, workload and the risk of supply failure. Where natural slopes are not available storage tanks could be raised on firm grounds to allow free flows and protections are done to avoid collapse of surrounding grounds (Meeks, 2012).

The risk of failure in drinking water infrastructure can result in water disruptions, impediments to emergency response, and damage to other types of infrastructure ASCE (2009). In May 2005 a huge flood washed part of the Sasumua dam embankment that resulted to loose of storage and property of huge magnitude downstream. In extreme situations, water shortages, whether caused by failing infrastructure or by drought, could result to water borne diseases.

Washed away and broken water main pipes could damage road ways structures and hinder fire controls efforts in case of emergencies. One of the greatest challenged facing water infrastructure in Kenya today has been storage, (Odira, 2010), investment in storage especially on large reservoir have been on a decline trend over year and this poses a great challenge in the near future. Water supply in Nairobi is characterized by notable achievements coupled with some challenges. Among the achievements is the expansion of infrastructure to be in line with increased population growth. This was a key step after the construction of Thika dam and associated water treatment plant at Ngethu and pipelines in the 1990's, and the changes that saw the transformation of the Municipal Water Department into an independent utility in 2003; and the more recent reduction of water losses – technically called Non-Revenue Water from 50% to 40% (Karanja, 2011). The key challenges include poor water quality at times due to high turbidity levels, and intermittent supply where we have about only 40% of those with connections receive water continuously.

At recent times, there is a high risk of loss reservoir volume by siltation that is accelerated by changes in land use in the Aberdare as revealed by a study on bathymetry (WRMA,2012). The above is pegged on the conditions of the existing infrastructure. Scheduled preventive maintenance is important as they increase the lifespan of the water infrastructure. The researcher intents to find more on this.

It is the view of the researcher that at given time the holding capacity or infrastructure should be sufficient enough to last uninterruptedly for over 6 months, in case of major shutdowns they should be restored with 36 hrs to avert water service provision crisis and hence investment in increased water supply infrastructure is prioritized (Karanja et al,2011).

2.6 Environmental factor and Water Service Provision

Water supply system is the product of its own environment Apec, (2013). The changes on environmental conditions have a major influence in water supply. The National Academies of Science (1999) noted that any notable increased in the precipitation or decreased precipitation over a prolonged period is likely to affect the inflows to water sources such as rivers, springs and wells. Water quality is known to markedly increase due to contamination levels and this reduces the available water supply due to drought conditions. Changes in the environment are likely directly or indirectly initiated and enhanced by human activities. These are most likely to affect the state of regional water supplies and demand.

The importance of the environment that includes the ecosystem services to the sustainability of water supplies is such a critical issue as we address the water service provisions. The National Academies of Science 1999, reports that environmental quality depends on maintaining good water quality and quantity and that such is dependence on environmental quality. This implies that without good services of natural ecosystems sustaining supplies quality water for the community could be difficult and costly.

Thus environmental concerns are central to sustainable water resources planning. The above demonstrates that there exists a relationship between the issues of biodiversity, water supply and quality. It is therefore of great importance that we maintain where possible restoring the ecosystem integrity.

With rapid population growth there is an ever increasing usage of ground water and surface water for agriculture, domestic and industrial use. This puts pressure on the existing environment. According to Majid, (2010) reports that by 2015 two thirds of the world population will have water stress and 1.8 billion persons will be living in areas with absolute water scarcity. Some of the harsh environmental factors includes; low and decreasing ground water levels due to low or lack of rainfall to recharge ground water, and the costs of access to lower ground waters becomes high, high variation seasonal rainfall, increasing high demand for irrigation water, for the pastures community unequal distribution of water increasing disputes between neighbors and states.

Increased pollution is likely to be experienced due to water scarce environment. Majid continues to report that countries like Bangladesh though has three major rivers, the rivers are full of sediment, polluted and thus slow moving making the process of water treatment extremely difficult for domestic use. Water consumption and demands at most time is guided the availability of both quantity and quality environment (Kithia,1997). An increase in water demand and usage has a direct proportional deterioration to water quality. At the same time waste discharges increase with rising water demand.

The amounts of water volume in river and intakes within the supplies of Nairobi Water are dependents on the rainfall amounts and distribution in the from the catchment areas. From the Gok Report on drought and risk management 2013/17, the country at large has experienced 28 droughts in the past 100 years at the very early years. This has changed over time where drought occurred every 10 years with the interval reducing to 2 year return periods. This could be attributed to changing climatic conditions that have drastically changed and the rainfall patterns are no longer tenable. The cycle has thus become shorter, frequent and even intense over time. This has pressed pressure to water resources and Nairobi County is no exception (Mwangi, 2011).

Rains failure have been reported to occurred in year 2000 and 2009 causing serious water rationing in the City (Sagwa, 2013). Such failures of the rains were repeated in 2016 causing a severe water shortage in the County. These shows increased frequency in rainfall failures. The upper Tana catchments received less than 300 mm total rains during the Short rains period in 2016 compared as compared to 700 mm in the previous 2 year performance (NCWSC, 2017). This was far below the expected rainfall performance. The upper catchments have suffered flooding that have affected infrastructure as well. Notably was the flush flooding (Coynet, 2005) that resulted to washing away of part of the dam embankment with loss of live reservoir storage.

Within the transmission mains we have had floods washing away the raw water main for about three times in the last three in ten years resulting to interruption on raw water transmission and almost total supply failure of water supply in the City (NCWSC, 2015).

2.7 Conceptual Framework

This study was guided by a conceptual framework on factors influencing water service provision by NCWSC to Nairobi County. A conceptual frame wok is a hypothetical model identifying the concepts under study and their relationship between the independent and dependent and also confounding variables. The section provides a structural description of the relationship between the variable forming the concepts of the study on water service provision. This is as presented in a schematic diagram Figure 1. The figure shows the relationship between the independent and dependent variable. These include water sources, water management, water supply infrastructures and environmental factor influences water provision positively and or negatively. There are also the intervening factors that also influence water provision among them social attitude towards water as a free resource. This is represented in the in a schematic diagram Figure 1.

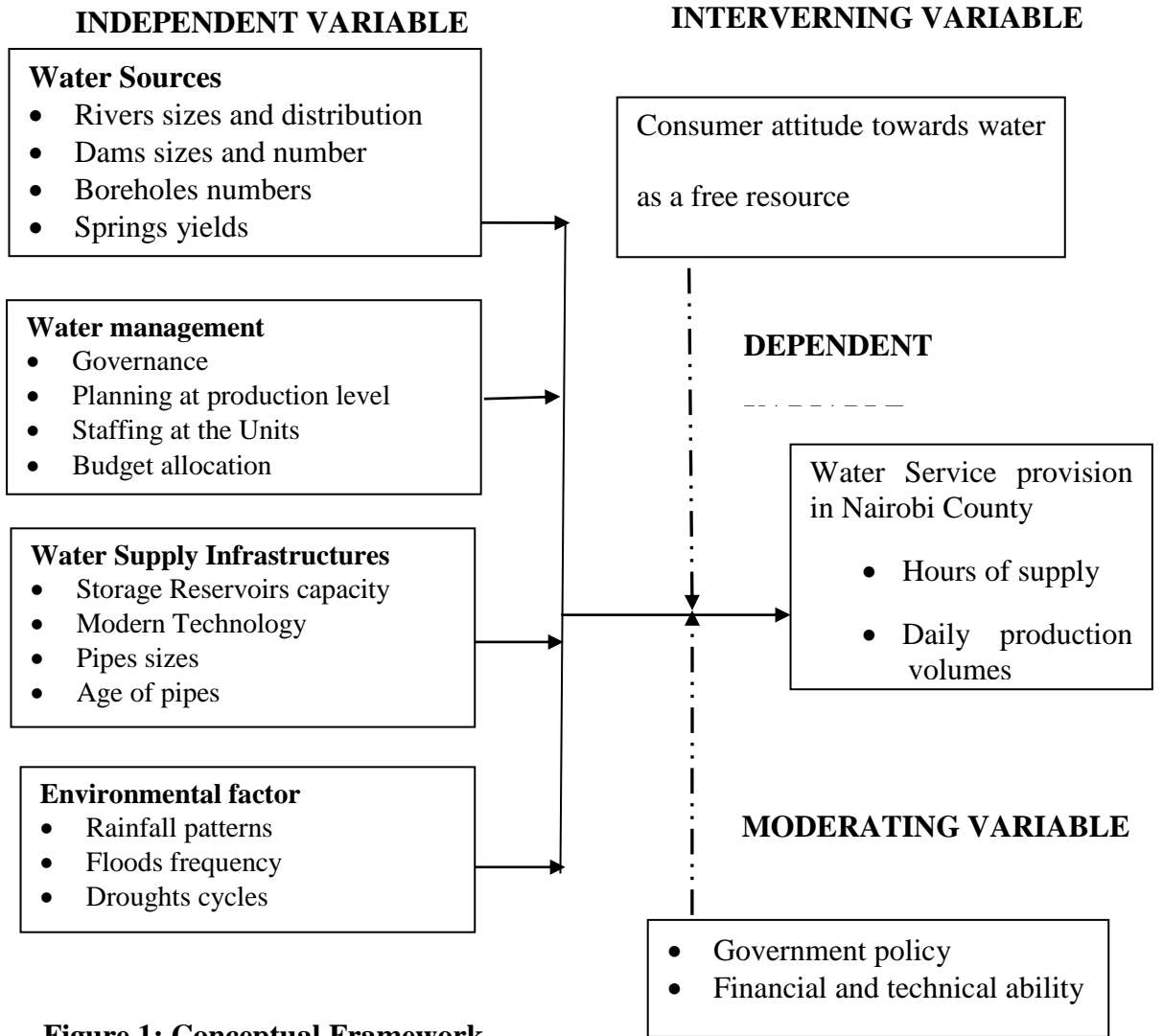


Figure 1: Conceptual Framework

2.8 Gaps in literature

Table 2. 1: Research gap knowledge table

Study	Focus	Findings	Knowledge gap
Muthama, 2013	Focused on the Technology and the way it affecting the efficiency of Water services provision by Nairobi	The study found that the use of technology has improved metering, revenue billing within the institution	Before metering of the consumers, the study failed to show the linkages that of water there is metering at the production and distribution levels. Before metering is the quantification of the raw as abstraction
Otieno S O 2010	Focused on factors affecting water governance and accessibility among households in huruma informal settlement, Nairobi	The key findings in the study was that high water costs was the greatest challenge affecting water access and provisions to Huruma estates residents of within Nairobi.	Water has a monetary value, the areas the study was done were informal settlements where cartels have been formed and have lots of control in pricing. The study did not examine the overall costs in terms of production and the larger service provision. It was highly localized.
Karimi A 2016	Focused on Assessment of quality water delivery service provision in Peri Urban, A case of Githurai	The key findings were that water quality parameters were within the recommended threshold except chlorine which was above standard.	Dosage of chlorine is done at the production level and this high chlorine could be attributed to un experienced staffing, poor maintenance of existing infrastructure among others

Onsomu,N 2013	Focused on the factors Influencing the Financial Viability of a Water Service Provider in Kenya: The Case of Gusii Water	The key findings of the study were that most WSPs are financially unsustainable. Due to weak management structures, processes and systems and poor systems of revenue collection.	The study focused on revenue without linking revenue to the source, which is raw water and their sources
Wangui S M 2012	Focused on the loss water through conveyance and how it affected storage A case of Nanyuki Water Company	The study concluded that loss of water through conveyance and storage affected provision of water to a great extent and hence the revenue base	The study focused on loss through conveyance affecting storages and revenue. It failed to check on factors of increased funding to water storage infrastructure and how it would impact on storage and revenue
Sagwa KM 2013	Focused on Environmental implications of small scale water Suppliers in Embakasi location, Nairobi,	The study concluded that there are many supply failures affecting water service provision due to power supplies on the bore holes and low yields	The study failed to give the various numbers of boreholes that are in the larger areas of Embakasi and their controlled yield. There are now costs calculated costs on over dependence on power than gravity flows

2.9 Summary of the Literature Review

The concept of water service provision has become a more frequent subject of discussion and study with time. This is solely because water is a limited resource and its distribution in quantity and quality is critical. It's a key resource not only in life

support but social economic development. Several factors influence water services provision in Nairobi that include water sources, water management, water supply infrastructure and environmental factor. Infrastructure development should be spear headed by the National Government. Supply hours from water sources, and the quantity of supplies are some notable dependent variables. Several researchers have been able to elaborate more on issues of metering, use of technology in billing, and invoicing, water tariff implementation effects but there exist gaps on factors at the production and transmission levels that could affect service provision in Nairobi,

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Introduction

In this chapter the researcher defines and describes the procedure that was followed in conducting the research. It describes the whole research process which includes research design, target population, sampling procedures, size, as well as the instruments that was used in data collection and analysis.

3.2. Research Design

Research design defines the techniques that are to be used in collecting data, sampling strategies and tools appropriate for a study (Chandran, 2004). It is the arrangement of conditions for collection and analysis of data in a manner that aims to instill relevance to the research purpose. The research design that was used by this study is descriptive survey. This is because it portrays an accurate profile of persons, events or situations and allows the collection of large amounts of data from a sizeable population in a highly economical way.

A descriptive design involves planning, organizing, collecting and analyzing of data so as to provide the information being sought (Saunders et al, 2007). It refers to the way the study is designed; the method was used to carry out a research. This research design involves gathering data that describe events and then organizes, tabulates, depicts, and describes the data that help in answering research questions or to test hypothesis of the current status on study. The study employed descriptive analysis to

establish opinions and knowledge about the factors influencing water service provision in Nairobi County.

3.3. Target Population

The target population for the study was 877 staff working in the production and distribution departments at Nairobi City Water and Sewerage Company (NCWSC) except the level of subordinate for the purpose of generalization. Kombo, (2006) defines a population as a group of individuals, objects or items from which samples are taken for measurement. It is from the Nairobi City Water and Sewerage Company that the respondents were drawn. The respondent included the top management, middle level management and lower cadre. The targeted population was provided by the management of Nairobi Water Company.

3.4 Sample Size and Sampling Procedure

3.4.1 Sampling size

The desired sample size was determined using the following Fisher et al. (1991) formulae:-

$$n = \frac{Z^2 pq}{d^2}$$

Where:

n = the desired sample size (when population is greater than 10,000).

Z = the standard normal deviation, set at 1.96, which corresponds to 95% confidence level.

p = the prevalence proportion set at 0.50 in accordance with the Fisher (1991) guide.

$$q = 1.0 - p$$

d = degree of accuracy desired, here set at 0.05 corresponding to the 1.96 z-statistic used in the numerator.

In substitution,

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

The Nairobi Water Company has total of 877 staff working in the production and distribution departments at therefore N=877 and since N is less than 10,000 the second formula was applied in determining the sample size. Thus: -

$$nf = \frac{n}{1 + \frac{n}{N}}$$

Where: -

nf = desired sample size for a population less than 10,000.

n = desired sample size for population more than 10,000 which is found to be 384.

N = Population which is 877.

Substituting,

$$nf = \frac{384}{1 + \frac{384}{877}} = 267$$

$$nf = \frac{384}{1 + 0.438} = 267$$

The desired sample size, n = 267.

The sample size of the study was 267 respondents. This constitutes a study proportion 30%. Orodho (2009) states that 10 to 20 percent sample of the population are representative enough to be used as a sample.

3.4.2 Sampling Procedure

The study adopted stratified random sampling technique to select respondents who were representative of the target population. Stratified sampling method was used as it involves dividing the target population into various units based on any unifying management. Once this has been done then the samples are drawn from each group (Chandran, 2004). For the purpose of this study, stratified sampling was adopted. According to Kothari (2000), a stratified random sampling is used where the population embraces a number of distinct categories, the frame can be organized by these categories into separate "strata." Each stratum was then sampled as an independent sub-population, out of which individual elements can be randomly selected.

The method assures the researcher that the sample is representative of the population. Stratified samplings as noted by Mugenda and Mugenda, (2003) is a method applied if the population from which a sample is to be drawn does not constitute an identical group, and hence requires comparisons between various sub-groups. Since the respondents are classified according to their management level, a stratified random sampling method was more suitable for this study. Simple random sampling was then used to select subjects from each stratum until the number of subjects in that stratum will be proportional to its frequency in the population. This ensured that different categories of population were adequately represented in the sample so as to increase the level of accuracy.

Nairobi Water Company has seven number directorates that include Technical, Human & Administrative Services, Legal, Information Communication and Technology, Internal Audit, Commercial and the Managing Directors Directorate. The Technical directorate is the largest in the Company operations and mainly formed by the production and distribution department that is further comprise of 6 water facilities. Simple random sampling was adopted to select the respondents from each stratum to avoid biasness in selecting the respondents.

Table 3. 1: Sampling Frame Table

Cadre	Number of staff	Sample Proportion	Sample size
Top Management	10	0.3	3
Middle Level Management	16	0.3	5
Supervisory	62	0.3	19
Artisans/Operators	305	0.3	92
Assistants	469	0.3	141
Totals	877		267

Source: NCWSC; Quarterly report Dec 2017

3.5 Data Collection Instrument

In this study the researcher used primary data that was collected with the help of a questionnaire, which was administered to the sampled population of the staff of Nairobi Water Company. The questionnaire was divided into sections, in line with the study objectives. The two techniques were; open and closed ended technique. Closed ended items were developed for they allow easier and accurate analysis of the data. They also make numerical comparison relatively easy while allowing a high degree of respondents' objectivity. They also reduce the problem of falsification. Open ended

questions were considered feasible in order to give the respondents a chance to deliver rich information and not to feel the constraints imposed by a fixed choice question.

The researcher used questionnaire that contained five sections. The first section deal with the general information. Section two consists of questions on the source of water supplied; the third question was on management of water, the fourth on water supply infrastructure and the fifth on environmental factor.

Secondary data was garnered from documented projects information and records. The questionnaires were self-administered since they had adequate instructions and simple, easy apprehend language was used. According to Kothari (2004) data collection is the means the study uses to gather the required data or information. The researcher prepared and delivered the questionnaire to the respondents. By use of research assistant's data collection was fast tracked. The research assistants also help to guide the respondents. Due to variance in availability of respondents the researcher also used drop off and pick later method of administering questionnaires. Drop off and pick later method result to high response rate and reduce researcher presence bias (Cooper and Schindler, 2003).

3.5.1 Pilot Testing

A pilot test is a stage where research instruments are administered to a number of individuals in the target population who are not included in the sample size so as to test reliability and validity of the instrument Mugenda and Mugenda, (2003). The researcher aimed to test whether the design of questions is logical, if questions were

clear and easy to understand, exhaustive and how long it would take to complete the questionnaire. The pre-test also allowed the researcher to check on whether the variables collected could easily be processed and analyzed. The pre-testing was carried at NCWSC – production department on a sample consisting of 10% of the respondents i.e. 8 respondents. Any questions found to be interpreted differently during the pre-testing were rephrased so that they could have the same meaning to all respondents. The views given by the respondents during pre-testing were used to improve the questionnaires before actual collection of data.

3.5.2 Reliability of the Instrument

Reliability defines or refers to the consistence of measurements and is more frequently assed using the aspect of test and retest reliability method. Reliability is increased by including many similar items on a measure, by testing a diverse sample of individuals and by using uniform testing procedures. Reliability gives the internal consistency of data collected. This ensures that the data has certain internal consistent pattern. When no pattern is found in the responses, this indicates that probably the test is too difficult and as a result the respondents just guess the answers randomly.

Reliability of the research instrument was enhanced through a pilot study done at NCWS by selecting a pilot group of 10 respondents. The respondents were conveniently selected since statistical conditions were not be necessary in the pilot study as suggested by Cooper and Schindler (2003). The pilot data was not included in the actual study. The pilot study allowed for pre-testing of the research instrument.

Table 3. 2: Reliability Results

Variable	Cronbach's Alpha	No. of Item
Water Sources	0.8345	5
Water management	0.8656	5
Water Supply Infrastructures	0.8987	5
Environmental factor	0.8298	5

In this study, reliability was ensured through a piloted questionnaire that was subjected to a sample of 10 staff working in the production and distribution departments at (NCWSC). The results obtained are presented in Table 3.2. From the findings, coefficient of water sources was 0.8345 making question items reliable. The Cronbach Alpha of water management was 0.8656 making items reliable. The items concerning water supply infrastructures were reliable as they had a Cronbach Alpha coefficient of 0.8987. The 4 items concerning environmental factor were reliable with Cronbach Alpha coefficient of 0.8298. This clearly indicated that the instrument for factors that influence water service provision in Kenya, Nairobi County presented to staff working in (NCWSC) for data collection was reliable as all the Cronbach Alpha were closer to 1 and greater than 0.7.

3.5.3 Validity of the Instrument

Validity is the degree by which the sample of test items represents the content the test is designed to measure Bridget et al, (2005). Saunders et al., (2007) indicated that content validity is a measure of the degree to which data collected using a particular instrument represents a specific domain or content of a particular concept as intended. Lacity (1994) explains and defines validity as making common sense of something and being persuasive and seeming right to the reader, while Cronbach, (1971),

indicated that validity refers to results that have the appearance of truth or reality. Therefore, a pilot study was conducted to refine the research instrument so that results obtained from the field would be a true representation of situation the ground.

Therefore, validation of the research instrument was important to the study as it ensured that the study collected relevant information to answer the research questions. Mugenda and Mugenda (2003) contend that the usual procedure in assessing the content validity of a measure is to use a professional or expert in a particular field.

The validity of data collected was ensured through using the opinions of experts in the field and as guided by the supervisor. The collection of data from the relevant respondents having been permitted by the University, respondents who had experience on the factors that influence water service provision in Kenya.

3.6. Data Analysis

The researcher verified collected questionnaire and examined whether they are dully filled. Researcher performed the data editing, coding, data entry and data cleaning activity in order to check the consistency of the data collected from the respondents by various tools. The researcher employed quantitative methods of analysis. Quantitative analysis was applied for the data collected through questionnaires. The data was analyzed by using Statistical software package for Social Science (SPSS 21); computer software. The researcher used simple descriptive statistics analysis to interpret the result. This includes frequency distribution, mean, standard deviation and percentages. Inferential statistics such as regression and correlation analysis were also

done to establish whether factors have significant influencing on Water Service Provision focusing on a case of Nairobi City Water and Sewerage Company, Kenya.

3.7 Ethical Consideration

Consent of the participants was sought where they agreed to participate in the study through voluntary informed consent without threat or undue inducement. In addition, the respondents were assured that the information they gave would be kept confidential and used only for the purpose of research. For anonymity the respondents were requested not to write their identities in the questionnaire section while the appropriate chain of command was followed before the commencement of the data collection process.

Table 3. 3: Operationalization of Variables

Objective	Variable	Indicators	Measurements Scales	Data collection method	Types of Analysis
Independent variable					
To determine how water sources influence water service provision in Nairobi County.	Water Sources	Rivers sizes and distribution Dams sizes and number Boreholes numbers and yields Springs yield	Ordinal Nominal	Questionnaire/ Interview	Descriptive statistics Correlation Regression
To find out how water management influence water service provision in Nairobi County	Water management	Governance Planning at production level Staffing at the Units Budget allocation	Nominal Nominal	Questionnaire/ Interview	Descriptive statistics Correlation Regression
To determine how the existing water supply infrastructure influences water service provision in Nairobi County	Water Supply Infrastructure	Reservoirs capacity Modern Technology Pipes sizes Age of pipes	Ordinal Nominal	Questionnaire/ Interview	Descriptive statistics Correlation Regression
To assess how environmental factor influences water service provision in Nairobi County.	Environment Factors	Rainfall patterns Floods frequency Droughts cycles	Ordinal Nominal	Questionnaire/ Interview	Descriptive statistics Correlation Regression
Dependent Variable					
Factors influencing water service provision	Provision of Water	Quantity Supplied Hours of supply Daily production volumes	Ordinal Nominal	Questionnaire	Descriptive statistics Correlation Regression

CHAPTER FOUR

DATA ANALYSIS PRESENTATION AND INTERPRETATION.

4.1 Introduction to Data Analysis

This chapter presents the results and findings of the study based on the research questions. The findings were given based on the four objectives of the study as explored using questions in the questionnaire.

4.1.1 Questionnaire response rate

Table 4.1: Response rate

	Frequency	Percent
Filled questionnaires	220	82
Un returned questionnaires	47	18
Total	267	100

A total of 267 staff working in the production and distribution departments at Nairobi City Water and Sewerage Company (NCWSC) were asked to respond to factors that influence water service provision in Kenya, Nairobi County by use of a questionnaire. A total of 267 questionnaires were administered to 267 sampled respondents who included top management, middle level management and lower cadre, 220 (82%) of the NWSCS sampled staff responded on time for data analysis. This rate was considered appropriate to derive the inferences regarding the objectives of the research.

4.2 General information of the Staff

The general demographic information in this sub-section was obtained by use of multiple choice questions for the staff to fill in order to establish the respondents gender, age, and academic qualifications.

Table 4. 2: Gender of the Respondents

	Frequency	Percentages
Male	127	58
Female	93	42
Total	220	100

The study sought the gender of the respondents. From the findings, majority 127 (58%) of the respondents were male while 93 (42%) of the respondents were female a good equitable gender representation.

Table 4.3: Age of the Respondents

	Frequency	Percentages
21- 30	49	22
31 – 40	136	62
41- 50	22	10
51 – 60	13	6
Total	220	100

Respondents were requested to indicate the age bracket in which they were in. From the findings, majority 136 (62%) of the respondents indicated that they were aged between 31-40 years, 49 (22%) of the respondents indicated that they were aged

between 21-30 years. From the findings most 22 (10%) of the respondents were aged between 41-50 years while 13 (6%) of the respondents indicated that they were aged between 51-60 years. This implies that the staff working in the production and distribution departments at Nairobi City Water and Sewerage Company are of productive age, experienced and information they gave was valid.

Table 4.4: Highest Academic Qualifications

Responses	Frequency	Percent
Degree	99	45
Diploma	81	37
Secondary	40	18
Total	220	100

Respondents were requested to indicate their highest academic qualifications. From the findings, majority 99 (45%) of the respondents indicated that they had degree highest level of education, most 81 (37%) of the respondents indicated that they had diploma level of education while 40 (18%) of the respondents indicated that they had secondary level of education. This implies that the data was collected from educated respondents and therefore they understood the required information and gave reliable response.

4.3 Water Sources and Water Provision

The researcher sought to know how water sources affect the water accessibility. The response was presented in the Table 4.5.

Table 4.5: Main sources of Water at Respective Production Site

Sources of water	Frequency	Percent	Frequency	Percent
	Yes	(Yes)	No	(No)
Dams	218	99	4	2
Boreholes	196	89	53	15
Runoff the river	205	93	33	24
Weir intakes	180	82	88	40
Springs	189	86	68	31

The study investigated the information of the main sources of water at respective production site. From the findings, majority 218 (99%) of the respondents indicated that the main sources of water is dams, 196 (89%) of the respondents indicated that the main sources of water is boreholes, 205 (93%) of the respondents indicate that the main sources of water is runoff the river, 189 (86%) of the respondents indicated that the main sources of water is springs while 180 (82%) of the respondents indicated that the main sources of water is weir intakes. This implies that there were various main sources of water in the Nairobi County. This is in line with NCWSC Strategic Plan, (2014/15) which acknowledges that as a natural resource, development of the sources and especially dams, runoff river and weir intakes are critical as water sources and their development is critical for sustainable water provision to the City.

Table 4.6: Extent to which the sources of water are reliable

Responses	Frequency	Percent
Moderate extent	117	53
Very great extent	73	33
Great extent	31	14
Total	220	100

The respondents were requested to indicate the extent to which their sources of water were reliable. From the findings, majority 117 (53%) of the respondents indicated that the sources of water they have are reliable to a moderate extent. Most 73 (33%) of the respondents indicated that the sources of water they have are reliable to a very great extent while 31 (14%) of the respondents indicated that sources of water they have are reliable to a great extent. This implies that available sources of water in Nairobi were reliable to a moderate extent. This is in line with NCWSC Strategic Plan, (2014/15) which acknowledge that development of reliable sources that are accessible will go along in support of the NCWSC slogan “improving reliability.

Table 4.7: Whether water treated at the production plants is sufficient quantity

Responses	Frequency	Percent
Yes	150	68
No	70	32
Total	220	100

The respondents were requested to indicate on whether the water treated at the production plants is sufficient to the customers in the Nairobi County. From the findings, majority 150 (68%) of the respondents indicated that the water treated at the production plants is sufficient to the customers in the Nairobi County while 70 (32%)

of the respondents indicated that water treated at the production plants is not sufficient to the customers in the Nairobi County. This is in line with Egis, (2015) who indicates that there is a daily water deficit of 200, 000 m³/day since the current water supply in the City is 520,000 m³/day and the present demand for water is 720,000 m³/day.

Table 4.8: Extent to which water source influence water service provision

Statement	Mean	Standard deviation
Low production that fails to meet increasing demand	4.51	0.76
High water losses along transmission mains	4.28	0.49
Inadequate education on water usage	4.79	0.78
Low water yields	4.68	0.64
Source of water reliability	4.55	0.56
Inadequate water supply	4.61	0.78
Insufficient storage dams	4.83	0.88

Respondents were requested to indicate the extent to which water source influence water service provision in Nairobi City Water and Sewerage Company. From the findings, majority of the respondents indicated that insufficient storage dams, inadequate education on water usage and low water yields affect water service provision in Nairobi City Water and Sewerage Company to a very great extent as indicated by mean of 4.83, 4.78 and 4.68 with standard deviation of 0.88, 0.78 and 0.64. Most of the respondents indicated that inadequate water supply, source of water reliability and low production that fails to meet increasing demand affect water service provision in Nairobi City Water and Sewerage Company to a very great extent as indicated by mean of 4.61, 4.55 and 4.51 with standard deviation of 0.78, 0.56 and

0.76. Most of the respondents indicated that high water losses along transmission mains affect water service provision in Nairobi City Water and Sewerage Company to a great extent as indicated by mean of 4.28 with standard deviation of 0.49. This implies that water source influence water service provision.

This is in line with Allube, (2011) who indicate that the water crisis is not only due to drought wave, but also from other aspects like water sources inhibited by poor management, under investment in infrastructure, rampant deforestation, huge population explosion.

Table 4. 9: Correlation between Water Source and Water Service Provision

		Water service provision
Water Source	Pearson Correlation	.799**
	Sig (2-tailed)	.001
	N	220

** - Correlation is significant at the 0.01 (2 tailed)

* - Correlation is significant at the 0.05 (2 tailed)

The results in Table 4.9 shows that there is a strong, significant and positive correlation between water sources and water service provision where $r=0.799$, $PV=0.001 < 0.01$). The regression results (Appendix iii) indicated that predictor water sources had a statistically significant and positive relation with water service provision in Nairobi County $\beta_1=0.681$, $PV=0.02 < 0.05$, $t=4.912$.

4.4 Water Management and Water Service Provision

The respondents were asked to indicate how management in NCWSC of the existing facilities affects the water service provision. The results are tabulated in the Table 4.10.

Table 4.10: Whether aware of the existing water rules that govern water service provision

Responses	Frequency	Percent
No	145	66
Yes	75	34
Total	220	100

Respondents were requested to indicate whether they were aware of the existing water rules that govern the overall organization. From the findings, majority 145 (66%) of the respondents indicated that they were not aware of the existing water rules that govern the overall organization while 75 (34%) of the respondents indicated that they were aware. This implies that lack of awareness of existing water rules that govern the overall organization is among the factors that influence water service provision in Kenya. This is in line with Krhoda, (2008) who reported that lack of awareness and rules that govern water service provision in Kenya and to a larger effect sub Saharan Africa that water resource management that hinder s water provision.

Table 4.11: Extent to which management involve stakeholders in water management

Responses	Frequency	Percent
Moderate extent	112	51
Great extent	82	37
Very great extent	26	12
Total	220	100

Respondents were requested to indicate the extent to which management involved the stakeholders in water management in the organization. From the findings, majority 112 (51%) of the respondents indicated that the management involved stakeholders in water management to a moderate extent, 82 (37%) of the respondents indicated to a great extent while 26 (12%) of the respondents indicated that the management involved stakeholders in water management to a very great extent. This implies that the management involved stakeholders in water management to a moderate extent. This is in line with WASREB 2013/14 impact report that indicated growth on the stake holder involvement by management in the process of designing and maintaining of water service provision to meet the changing water demand. This has seen creation of annual stake holder workshop meeting to its customers NCWSC Strategic Plan 2013/2014 to continually have an engagement with them and see areas to improve on water service provision.

Table 4.12: Water management influence water service provision

Statement	Mean	Std Dev
There exist adequate regulations on water management	4.33	0.43
There are competent and qualified staff involve in management of water	4.08	0.31
Employees participate in management of water	4.78	0.53
There sufficient resources for effective water management	4.75	0.76
Stakeholder are engaged in management of water provision	4.79	0.68
Decision making process on water management is effective	4.56	0.51
The source of water is well located	4.61	0.59

Table 4.12 shows the response on the extent to which water management influence water service provision in Nairobi City Water and Sewerage Company. From the findings, majority of the respondents indicated that stakeholder were engaged in management of water provision, employees participated in management of water and there were sufficient resources for effective water management affect water service provision in Nairobi City Water and Sewerage Company to a very great extent as indicated by mean of 4.79, 4.78 and 4.75 with standard deviation of 0.68, 0.76 and 0.53. Most of the respondents indicated that the source of water was well located, and there was effective decision making process on water management thus affecting water service provision in Nairobi City Water and Sewerage Company to a very great extent as indicated by mean of 4.61 and 4.56 with standard deviation of 0.59 and 0.51. Most of the respondents indicated that there exist adequate regulations on water management and there were competent and qualified staff involve in management of water thus influencing water service provision in Nairobi City Water and Sewerage

Company to a great extent as indicated by mean of 4.33 and 4.08 with standard deviation of 0.43 and 0.31. This implies water management influence water service provision. This is in line their internal policy that functional management units shall be established within each directorate that shall be monitored in performance from time to time NCWSC 2015 and with Kootz et al 2004 who stated that established systems and structures on management on water resources by the government has efficiently accomplish responsibilities to improve water service provision.

Table 4. 13: Correlation between water Management and Water Service provision

		Water service provision	Water source	Water management	Water supply infrastructures	Environmental factor
Water Management	Pearson Correlation	.711*	.769	1		
	Sig (2-tailed)	.021	.0191			
	N	220	220	220		

** - Correlation is significant at the 0.01 (2 tailed)

* - Correlation is significant at the 0.05 (2 tailed)

The results in Table 4.13 shows that there existed significant and positive correlation between water management and water service provision where $r=0.711$, $PV=0.021 < 0.01$. The regression results (Appendix iii) indicated that Predictor water management has a significant and positive relationship with water service provision in Nairobi County as $\beta_2=.529$, $PV=0.03$, $t=5.515$,

4.5 Water Supply Infrastructure and Water Service Provision

The third research question for this study was to establish how water infrastructure affect water service provision and the findings are shown in the Table 4.14

Table 4.14: Rating the existing water supply infrastructure in Nairobi Water

	Frequency	Percent
Bad	73	33
Good	57	26
Very good	55	25
Excellent	35	16
Total	220	100

The respondents were requested to rate the existing water supply infrastructure in Nairobi Water. From the findings, 73 (33%) of the respondents rated the existing water supply infrastructure in Nairobi Water as bad, 57 (26%) of the respondents rated the existing water supply infrastructure in Nairobi Water as good, 55 (25%) of the respondents rated the existing water supply infrastructure in Nairobi Water as very good, 35 (16%) of the respondents rated the existing water supply infrastructure in Nairobi Water as excellent. This implies that most of the respondents indicated that existing water supply infrastructure in Nairobi Water is bad therefore affecting the provision of water services in Nairobi. This is in line with United Nations, (2010) that states that deteriorating infrastructure, poor maintenance, lack of new investments, unstable funding in the sector increases pollution of water resources, unclear legislative framework for managing water and lack of sector policy on water resources management lead to poor supply infrastructure.

Table 4.15: Preventive maintenance Schedule at work place

	Frequency	Percent
Yes	130	59
No	90	41
Total	220	100

Respondents were requested to indicate whether aware of the preventive maintenance schedule at work place. From the findings, majority 130 (59%) of the respondents were aware of the preventive maintenance schedule at work place while 90 (41%) of the respondents were not aware of the preventive maintenance schedule at work place. This implies that preventive maintenance schedule at work place improve the supply infrastructure thus influencing the water services provision. This is in line with White Paper, (2013) scheduled preventive maintenance is important as they increase the lifespan of the water infrastructure.

Table 4.16: Extent to which water supply infrastructure influence water service provision

Statement	Mean	Std dev
The company has appropriate technology	4.57	0.53
The company has sufficient water loss reduction methods	4.60	0.63
There is ineffective maintenance system	4.33	0.35
There sufficient resources for effective water management	4.50	0.45
There is ineffective reporting on water losses	4.21	0.36
There is inadequate water supply equipment	4.26	0.39
The company has inadequate distribution systems	4.18	0.23
Water storage system is sufficient	4.53	0.45

The study sought the extent to which water supply infrastructure influence water service provision in Nairobi City Water and Sewerage Company. From the findings, majority of the respondents indicated that the company has sufficient water loss reduction methods, appropriate technology and water storage system is sufficient as well as sufficient resources for effective water management affecting water service provision in Nairobi City Water and Sewerage Company to a very great extent as

indicated by mean of 4.60, 4.57 and 4.53 with standard deviation of 0.63, 0.53 and 0.55. Most of the respondents indicated that there were sufficient resources for effective water management affecting water service provision to a very great extent as indicated by mean of 4.50 with standard deviation of 0.45. Most of the respondents indicated that there is ineffective maintenance system, inadequate water supply equipment, ineffective reporting on water losses and inadequate distribution systems therefore affecting water service provision to a very great extent as indicated by mean of 4.33, 4.26, 4.21 and 4.18 with standard deviation of 0.35, 0.39, 0.36 and 0.23. This implies that supply infrastructure influence water service provision. This is in line with findings Karanja, (2011) who stated that the supply infrastructure should be sufficient enough to last uninterruptedly for over 6 months on dry spell sets and 36 hours of recovery in cases of water service provision major shut downs. Investments in water supply infrastructure investment should be prioritized.

Table 4. 17: Correlation between Water Supply Infrastructures and Water Service Provision

		Water service provision
Water Supply Infrastructures	Pearson Correlation	.721*
	Sig (2-tailed)	0.037
	N	220

**-Correlation is significant at the 0.01 (2 tailed)

*- Correlation is significant at the 0.05 (2 tailed)

The study revealed that there existed a strong, significant and positive correlation between water supply infrastructures and water service provision, $r=0.721$, $PV=0.037 < 0.05$. Regression results in (appendix iii) indicated that predictor water

supply infrastructures had a significant positive relation with water service provision as $\beta_3 = 0.668$, $P = 0.01$ and $t = 3.272$.

Respondents were requested to indicate their opinion on the solutions that could improve water supply infrastructure in Nairobi. From the findings, respondents unanimously indicated that there is need to innovate around water quantity and quality, ensure compliance with the standards on quality, service levels agreements and performance established by WASREB. Respondents further stated that scheduling for preventive maintenance is important as they increase the lifespan of the water infrastructure. This implies that solutions given to improve water supply infrastructure influence the water service provision. This is in line with Meeks (2012) who states that in developing countries, households without water supply infrastructure spend billions of hours collecting water for domestic use every year.

4.6 Environmental Factor and Water Service Provision

The fourth research question for this study was to establish how water infrastructure affect water service provision and the findings are shown in the Table 4.18.

Table 4.18: Pollutants of water from the catchments sources

	Frequency		% of yes
	Yes	No	
Industrial	202	18	92
Fertilizers	194	26	88
Pesticides	200	20	91
Land use changes	189	31	86

Table 4.15 shows the response on the most likely pollutants of water from the catchments sources. From the finding, majority 202 (92%), 200 (91%), 194 (88%) and 186 (86%) of the respondents indicated that pollutants of water from the catchments

sources are industrial, pesticides, fertilizers and land use changes. This implies that water quality decrease due to contamination levels and this reduces the available water supply. This is in line with White Paper, (2013) who stated that environmental concerns are central to sustainable water resources planning.

Table 4.19: Human activities in the catchments heavily influence raw water qualities at the catchments

	Frequency	Percentages
Strongly Agree	108	49
Agree	79	36
Disagree	33	15
Total	220	100

The results in Table 4.16 show the response on agreeing whether human activities in the catchments heavily influence raw water qualities at the catchments. From the findings 108 (49%) strongly agreed that human activities in the catchments heavily influence raw water qualities at the catchments 79 (36%) agreed while 33 (15%) disagreed. This is in line with White Paper, (2013) who stated that changes in the environment are likely directly or indirectly initiated and enhanced by human activities. These are most likely to affect the state of Nairobi County water service provision.

Table 4. 20: Environmental factor influence water service provision

Statement	Mean	Standard deviation
Climate considerations	4.84	0.75
Weather Information management	4.45	0.43
Increase in water pollutants at the catchments sources	4.92	0.85
Planning of water use	4.36	0.35
Human activities in the catchments heavily influence raw water qualities at the catchments	4.21	0.30
Growth of populations	4.90	0.88
Change in weather pattern	4.72	0.54
Environmental campaigns	4.87	0.78
The climatic change influence fluctuation of water supply	4.55	0.43
The source of water is well located	4.72	0.65

The study sought the extent to which environmental factor influence water service provision in Nairobi City Water and Sewerage Company. From the findings, majority in great extent of the respondents indicated that increase in water pollutants at the catchments sources, growth of populations, environmental campaigns and climate considerations are the environmental factors that affect water service provision in Nairobi City Water and Sewerage Company to a very great extent as indicated by mean of 4.92, 4.90, 4.87 and 4.84 with standard deviation of 0.85, 0.88, 0.78 and 0.75. Majority of the respondents indicated that the source of water is well located, change in weather pattern and the climatic change affect fluctuation of water supply influence water service provision to a very great extent as indicated by mean of 4.72, 4.72 and 4.55 with standard deviation of 0.65, 0.54 and 0.43.

Most of the respondents indicated that weather information management, planning of water use and human activities in the catchments heavily affect raw water qualities at the catchments to a very great extent as indicated by mean of 4.45, 4.36 and 4.21 with standard deviation of 0.43, 0.35 and 0.30. This implies that environmental factor influence water service provision. This is in line with Kithiia and Ongweny, (1997) who argued that water consumption and demands at most time is guided the availability of both quantity and quality environment.

Table 4. 21: Correlation between Environmental Factor and Water Service Provision

		Water service provision
Environmental Factor	Pearson Correlation	.656**
	Sig (2-tailed)	0.03
	N	220

**-Correlation is significant at the 0.01 (2 tailed)

*- Correlation is significant at the 0.05 (2 tailed)

The results indicated that that there exist a strong, significant and positive relationship between environmental factor and water service provision as $r=0.656$, $PV=0.03 < 0.01$. The study found that increase in water sources, efficient water management and water supply infrastructure would lead to increase in water services provision while good environmental conditions has a positive relationship with water services provision. The regression results (Appendix iii) also indicated that predictor environmental factor had a significant, positive relationship with water service provision as $\beta_4 = 0.592$, $PV=0.04$, $t=0.645$.

CHAPTER FIVE
SUMMARY OF FINDINGS, DISCUSSION, CONCLUSIONS AND
RECOMMENDATIONS

5.1 Introduction

This chapter describes the summary of findings from the study, conclusions, and recommendations of the study which was to investigate factors that influence water service provision in Kenya, Nairobi County. As has been established in the data analysis, there are several factors influencing water service provision in Nairobi, Kenya. These are the water sources, water management, water supply infrastructure and environmental factor.

5.2 Summary of Study Findings

In this section, summary of findings follow the order of research objectives and data as presented in chapter four. The purpose of this study is to investigate the factors influencing water service provision, a case of Nairobi City Water and Sewerage.

5.2.1 Water Source Influence on Water Provision

The first objective of the study was to determine how water sources influence water service provision in Nairobi County. The study established that there were various main sources of water in the Nairobi County including dams, boreholes, runoff the river, weir intakes and springs that were reliable. However, water treated at the production plants is sufficient to only 68% of the customers in the Nairobi County as the daily

water deficit of 200, 000 m³/day since the current water supply in the City is 520,000 m³/day and the present demand for water is 720,000 m³/day.

From the findings, water source affect water service provision as the insufficient storage dams, inadequate education on water usage and low water yields affect water service provision in Nairobi City to a very great extent. Water losses along transmission mains, inadequate water supply, water reliability and low production that fail to meet increasing demand thus influencing water service provision in Nairobi City Water and Sewerage Company to a very great extent.

Research findings revealed that there was a there is a strong, significant and positive correlation between water sources and water service provision where $r=0.799$, $P V=0.001<0.01$). The outcome of the regression analysis indicates that water sources had a statistically significant and positive relation with water service provision in Nairobi County.

5.2.2 Water Management Influence on Water Provision

From the findings, water management influence water service provision in Nairobi City Water and Sewerage Company. From the findings, 34% of respondents indicating that they were aware of the existing water rules that govern the overall organization, the study established that lack of awareness of existing water rules that govern the overall organization is among the factors that influence water service provision in Nairobi. The study established that management involved stakeholders in water management to a moderate extent. The study revealed that stakeholder are engaged in management of water provision, employees participated in management of

water and there were sufficient resources for effective water management influence water service provision by Nairobi City Water and Sewerage Company.

Source of water was well located, and there was effective decision making process on water management, adequate regulations on water management and there were competent and qualified staff involve in management of water thus influencing water service provision in Nairobi City Water and Sewerage Company. The study revealed existence of a strong, significant and positive correlation between water management and water service provision.

5.2.3 Water supply infrastructure influence on water provision

From the findings, existing water supply infrastructure in Nairobi Water was inadequate. The study reveals that preventive maintenance schedule at work place improve the supply infrastructure thus influencing the water services provision. There were sufficient resources for effective water management, however ineffective maintenance system, inadequate water supply equipment, ineffective reporting on water losses and inadequate distribution systems affected water service provision to a very great extent. Water supply infrastructures have a strong significant and positive correlation with water service provision. There also exists a significant and positive regression relationship.

5.2 .4 Environmental factor influence on water provision

The study established pollutants of raw water from the catchments sources to be the industrial, pesticides, fertilizers and land use changes. Human activities in the catchments heavily affect raw water qualities at the catchments. The study further found that increase in water pollutants at the catchments sources, growth of

populations, environmental campaigns and climate considerations, source of water being well located, change in weather pattern and the climatic change that affects the fluctuation of water supply, weather information management and planning of water use heavily affects water service provision in Nairobi City. The outcome of the inferential statistics indicates that there exist a strong, significant and positive correlation between environmental factor and water service provision.

5.3 Discussions

This section of the report discusses in detail the findings and compares them with literature reviewed in chapter two.

5.3.1 Water source influence on water provision

The descriptive results indicated that insufficient storage dams, inadequate education on water usage and low water yields affect water service provision in Nairobi City Water and Sewerage Company to a very great extent as indicated by mean of 4.83, 4.78 and 4.68 with standard deviation of 0.88, 0.78 and 0.64. The results concurred with KIWASCO (2007) that water sources which require little or no treatment of the water influence quantity of water required is available. Inadequate water supply, source of water reliability and low production that fails to meet increasing demand affect water service provision in Nairobi City Water and Sewerage Company to a very great extent as indicated by mean of 4.61, 4.55 and 4.51 with standard deviation of 0.78, 0.56 and 0.76. Further high water losses along transmission mains affect water service provision in Nairobi City Water and Sewerage Company to a great extent as indicated by mean of 4.28 with standard deviation of 0.49. Allube, (2011) revealed that the water crisis is not only due to drought wave, but also from other aspects like

water sources inhibited by poor management, under investment in infrastructure, rampant deforestation, huge population explosion. Correlation results indicated that there existed a strong, significant and positive correlation between water sources and water service provision where $r=0.799$, $P V=0.001<0.01$). Further regression results revealed water sources had a statistically significant and positive relation with water service provision in Nairobi County $\beta_1=0.681$, $PV=0.02<0.05$, $t=4.912$. The findings are supported by Meeks (2012) that water source play a significant role in influence adequate supply of water to residents in different areas.

5.3 .2 Water management influence on water provision

The study sought the extent to which water management in NCWSC influence the water service provision in Nairobi County. Descriptive results revealed that water management influence water service provision in Nairobi City Water and Sewerage Company. Failure to engage the stakeholder, increase in employees participation in management of water and allocation of sufficient resources for effective water management affect water service provision in Nairobi City Water and Sewerage Company to a very great extent as indicated by mean of 4.79, 4.78 and 4.75. Source of water was well located, and there was effective decision making process on water management thus affecting water service provision in Nairobi City Water and Sewerage Company to a very great extent as indicated by mean of 4.61 and 4.56 with standard deviation of 0.59 and 0.51. The findings concurred with Kootz et al. (2004) that established systems and structures on management on water resources by the government has efficiently accomplish responsibilities to improve water service provision. Correlation analysis indicated that there is a positive correlation between

water management and water service provision where $r=0.711$, $PV=0.021 < 0.01$. The results are supported by Owuor, et al. (2006) that management features in Nakuru caused persistent failure and inability of most local authorities in the provision of water supply and sanitation services. Further regression results revealed that water management has a significant and positive relationship with water service provision in Nairobi County as $\beta_2=.529$, $PV=0.03$, $t=5.515$. The finding concurred with Moraa, Atieno and Salim, (2012) that water resources management had a significance influence of quality water provision for domestic and industrial use.

5.3 .3 Water supply infrastructure influence on water provision

The third research objective was to establish how water infrastructure affects water service provision. The findings revealed that company has sufficient water loss reduction methods, appropriate technology and water storage system is sufficient as well as sufficient resources for effective water management affecting water service provision in Nairobi City Water and Sewerage Company to a very great extent as indicated by mean of 4.60, 4.57 and 4.53 with standard deviation of 0.63, 0.53 and 0.55. Sufficient resources for effective water management affecting water service provision to a very great extent and that ineffective maintenance system, inadequate water supply equipment, ineffective reporting on water losses and inadequate distribution systems therefore affecting water service provision to a very great extent as indicated by mean of 4.33, 4.26, 4.21 This implies that supply infrastructure influence water service provision. This is in line with findings Karanja, (2011) who stated that the supply infrastructure should be sufficient enough to last uninterruptedly for over 6 months on dry spell sets and 36 hours of recovery in cases of water service

provision major shut downs. Investments in water supply infrastructure investment should be prioritized. The study revealed that there existed a strong, significant and positive correlation between water supply infrastructures and water service provision, $r=0.721$, $PV=0.037<0.05$. Regression results in indicated that predictor water supply infrastructures had a significant positive relation with water service provision as $\beta_3=0.668$, $P=0.01$ and $t=3.272$.

5.3 .4 Environmental factor influence on water provision

The fourth research question for this study was to establish how environmental factors water infrastructure affects water service provision. From the findings, majority in great extent of the respondents indicated that increase in water pollutants at the catchments sources, growth of populations, environmental campaigns and climate considerations are the environmental factors that affect water service provision in Nairobi City Water and Sewerage Company to a very great extent as indicated by mean of 4.92, 4.90, 4.87 and 4.84.

The source of water is well located; change in weather pattern and the climatic change affect fluctuation of water supply influence water service provision to a very great extent as indicated by mean of 4.72, 4.72 and 4.55. The Findings indicated that information management, planning of water use and human activities in the catchments heavily affect raw water qualities at the catchments to a very great extent as indicated by mean of 4.45, 4.36 and 4.21. Correlation results indicated that exist a strong, significant and positive relationship between environmental factor and water service provision as $r=0.656$, $PV=0.03<0.01$. The regression results further indicated

that predictor environmental factor had a significant, positive relationship with water service provision as $\beta_4 = 0.592$, $PV = 0.04$, $t = 0.645$. This is in line with Kithiia and Ongweny, (1997) who argued that water consumption and demands at most time is guided the availability of both quantity and quality environment.

5.4 Conclusion

The study concludes that water sources influence provision of water to the County of Nairobi by NCWSC. The study conclude that the water service provision challenges is not only due to drought wave, but also from other aspects like water sources inhibited by poor management, under investment in infrastructure, rampant deforestation, huge population explosion among others.

The study concluded that water management in NCWSC of the existing facilities has a significant influence on the water service provision. Failure to engage the stakeholder, increase in employees participated in management of water and allocation of sufficient resources for effective water management affect water service provision in Nairobi City Water and Sewerage Company to a very great extent. Improved management on water resources by the government could efficiently improve service water provision.

The study concluded that water infrastructure affects water service provision. Adequate sufficient infrastructures and appropriate technology influence water service provision. The deterioration of infrastructure due to poor maintenance, lack of new investments, unstable funding in the sector, increased pollution of water resources in the catchments, population influx to the Nairobi, unclear legislative framework for

managing water and lack of sector policy on water resources management affect water service provision in Nairobi Water.

The study concluded that change environmental factors defined by weather pattern and the climatic change had a significant influence on water service provision to a very great extent. The results indicated that information management, planning of water use and human activities in the catchments heavily affect water qualities at the catchments, climatic conditions and change of whether affect water provision to a very great extent.

5.5 Recommendation

In light of the aforementioned findings, the following recommendations are made

The study recommends consideration of factors that influence water service provision in Kenya to enable the Nairobi County to offer sustainable access to safe drinking water to its residents. Nairobi City Water and Sewerage Company should ensure sufficient and reliable sources of water in the Nairobi County from the dams boreholes, runoff the river, weir intakes and springs.

The study recommends that the Nairobi City Water and Sewerage first priority should be to provide an adequate quantity of water and to protect water sources from contamination. The Government should support the company in coming up with alternative sources of water supply in Nairobi County as its mandated to spearhead investments funding in infrastructure development like in other key sectors like roads. In specific, the government should establish more water storage dams to meet the water needs for the Nairobi residents. There is need to innovate around water quantity

and quality, ensure compliance with the standards on quality, service agreements levels and performance established by WASREB.

The study recommends that local households should seek their own alternative sources like harvesting rainwater.

The County Government of Nairobi should assist the company by enacting strict by laws that can be enforced to residents that have illegal water connections. This would deter illegal connections that are rampant. Increased corporate social responsibilities (CSR) on metered water kiosks to such areas to make it easy access water.

There should be solutions to improve water supply infrastructure in order to influence the water service provision. Households without water supply infrastructure spend lots of hours collecting water for domestic use every year. The company should have a continually schedule for preventive maintenance as this increase the lifespan of the water infrastructure. Nairobi City Water and Sewerage should institute measures that ensure that pipe breakages and leakages are monitored and repaired. Such measures include introduction of online leakage detection.

Environmental concerns are central to sustainable water resources planning. There should well planned catchment management plans to effectively ensure environmental protection for in order to optimize the use of scarce water resources. Together with the county government the company should encourage public participation in the management, protection and conservation of the environment. It is recommended that human activities within the water catchments be monitored in order to protect water quality.

5.6 Recommendation for further studies

The findings in the study implies a positive influence of water sources, water management, water supply infrastructures and environmental factor on Water Service Provision by the Nairobi City Water and Sewerage Company, therefore there is a need for a more elaborate research to accurately quantify the factors that influence water service provision in Kenya.

Further study should be carried out to determine determinants influencing water provision by other private water companies. Given these considerations, there will be conclusive results on the factors that influence water service provision in Kenya. Much more needs to be known about factors affecting water service provision are likely to be elevated and how to mitigate their impacts and improve water service provision in the county.

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APPENDICES

APPENDIX I: LETTER OF TRANSMITTAL

Joseph T Karanja,
P.O Box 30656 -
00100,
Nairobi.

Dear Respondent,

RE: ACADEMIC RESEARCH

I am a student of the University of Nairobi pursuing a Masters of Arts Degree in Project Planning and Management. I am conducting academic research on factors influencing Water Service provision in Kenya, a case study of Nairobi City Water and Sewerage Company Limited.

I humbly request you to fill the enclosed questionnaire. The questionnaire has four sections that will focus on water sources, water management, infrastructure and environment

Kindly note that all the information provided for this study will be treated with utmost confidentiality and will be used only for the purpose of my academic research. Your ability to answer all the questions comprehensively and to the best of your knowledge will be highly appreciated.

The completed questionnaire will be picked from you two weeks after delivery.

Thank you for your co-operation.

Yours faithfully,

Joseph Karanja

E-mail: jkaranjat@yahoo.co.uk

Phone: 0722 748 196.

APPENDIX II: QUESTIONNAIRE TO NCWSC STAFF

Section I: Background Information

1. Indicate your Gender by use of (√) .
Male () Female ()
2. Indicate your age (in Years) in the appropriately box by use of (√)
21- 30 () 31 – 40 () 41- 50 () 51 – 60 ()
3. What is your highest academic qualifications
Primary (B) Secondary (C) Diploma (D) Degree
Others

Section II: Water Sources and Water Service Provision

4. Which are the main sources of water at your respective production site?
Please tick (√) all relevant.
Dams ()
Boreholes ()
Runoff the river ()
Weir intakes ()
Springs ()
All the above ()
5. To what extent is the source of water reliable tick (√)?
Very great extent ()
Great extent ()
Moderate extent ()
Less extent ()
Not at all ()
Give reasons for your answer.....
6. Is the water treated at the production plants is sufficient to the customers in the Nairobi County please tick (√) appropriately.

Yes ()

No ()

7. Indicate the extent to which water source influence water service provision in Nairobi City Water and Sewerage Company ? (Where 1-Not at all, 2-Less extent, 3-Moderate Extent, 4 –Great extent and 5 -Very Great extent)

Statement	1	2	3	4	5
Low production that fails to meet increasing demand					
High water losses along transmission mains					
Inadequate education on water usage					
Low water yields					
Source of water is reliable					
Inadequate water supply					
Insufficient storage dams					

Section III: Water Management and Water Service Provision

8. Are you aware of the existing water rules that govern the overall organization?

Yes ()

No ()

9. To what extent do management involve stakeholders in water management please tick (√) appropriately

Very great extent ()

Great extent ()

Moderate extent ()

Less extent ()

Not at all ()

Give reasons for your answer.....

10. Indicate the extent to which water management influence water service provision in Nairobi City Water and Sewerage Company ? (Where 1-Not at all, 2-Less extent, 3-Moderate Extent, 4 –Great extent and 5 -Very Great extent)

Statement	1	2	3	4	5
There exist adequate regulations on water management					
There are competent and qualified staff involve in management of water					
Employees participate in management of water					
There sufficient resources for effective water management					
Stakeholder are engaged in management of water provision					
Decision making process on water management is effective					
The source of water is well located					

Section IV: Water Supply Infrastructure and Water Service Provision

11. How would you rate the existing Water supply infrastructure in Nairobi Water? please tick (√) appropriately

Excellent ()

Very good ()

Good ()

Bad ()

12. Are you aware of the preventive maintenance Schedule at your work place? please tick (√) appropriately

Yes ()

No ()

13. Indicate the extent to which water supply infrastructure influence water service provision in Nairobi City Water and Sewerage Company? (Where 1-Not at all, 2-Less extent, 3-Moderate Extent, 4 –Great extent and 5 -Very Great extent)

Statement	1	2	3	4	5
The company has appropriate technology					
The company has sufficient water los reduction methods					
There is ineffective maintenance system					
There sufficient resources for effective water management					
There is ineffective reporting on water losses					
There is inadequate water supply equipment					
The company has inadequate distribution systems					
Water storage system is sufficient					

14. In your opinion, indicate solutions that could improve water supply infrastructure in Nairobi.

.....

Section V: Environmental Factor and Water Service Provision

15. What are the most likely pollutants of water from the catchments sources? please tick (√) appropriately

Industrial () Fertilizers () pesticides () land use changes ()

16. Human activities in the catchments heavily influence raw water qualities at the catchments please tick (√) appropriately

i) Strongly Agree () ii) Agree () (iii) Disagree ()

17. Indicate the extent to which environmental factor influence water service provision in Nairobi City Water and Sewerage Company? (Where 1-Not at all, 2-Less extent, 3-Moderate Extent, 4 –Great extent and 5 -Very Great extent)

Statement	1	2	3	4	5
Climate considerations					
Weather Information management					
Increase in water pollutants at the catchments sources					
Planning of water use					
Human activities in the catchments heavily influence raw water qualities at the catchments					
Growth of populations					
Change in weather pattern					
Environmental campaigns					
The climatic change influence fluctuation of water supply					
The source of water is well located					

- 18 How would you rate the following variables on their levels of influence in in regard to water service provision by NCWSC to Nairobi County

Variable	1	2	3	4	5
Water Sources influence to water service provision					
Water Management influence to water service provision					
Water supply infrastructure influence on water service provision					
Environmental factor influence on water service provision					
There is timely supply of water					
There is adequate supply of water					

Appendix III: Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.863a	0.745	0.739	0.7850256

Goodness of Fit

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	15.839	4	3.95975	6.4254002	0.001a
Residual	132.497	215	0.616265		
Total	148.336	219			

Table: Beta Regression Coefficients

Model	Unstandardized Coefficients	Standardized Coefficients	t	Sig.
	B	Beta		
(Constant)	3.8725		2.011	.0012
Water Sources	0.681	0.614	4.912	0.02
Water Management	0.529	0.519	3.515	0.03
Water Supply Infrastructures	0.668	0.621	3.272	0.01
Environmental Factor	0.592	-0.505	-0.645	0.04