



UNIVERSITY OF NAIROBI

FACULTY OF BUILT ENVIRONMENT AND DESIGN

DEPARTMENT OF ARCHITECTURE

**CONTRIBUTIONS OF GOVERNANCE TO WATER AVAILABILITY IN MWINGI
TOWN**

BY

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W50/39186/2021

**A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF AWARD OF MASTERS OF
URBAN MANAGEMENT DEGREE AT DEPARTMENT OF ARCHITECTURE.**

JULY 2023


DECLARATION

I hereby declare that this Research Paper is my original work and has not been presented for examination in any university.

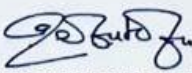
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DEDICATION

This work is dedicated to my entire family for their constant and continued support and encouragement throughout my education journey.

ACKNOWLEDGEMENT

I thank the Almighty God for His guidance and strength throughout the study period.

I am grateful to my supervisors Dr. Arch. Anthony Oduor Ralwala and Arch. Caleb Mutali for the valuable supervision, which helped me stay on course through the entire period of research. I thank you for your guidance, critique and encouragement needed which made this project improved and completed in time.

I appreciate support and valuable input from Eng. David Musau the Technical Manager Kiambere Mwingi Water and Sanitation Company in identification of problems at hand and during data collection, which aided in completion of this research project report.

I am grateful to my Mom Mrs. Felistus Lena Kathanzu for her support in every way throughout my academic life. Much appreciation to my siblings and other family members for their continued encouragement and prayers throughout my academic life. I am equally grateful to my mentor Dr. Boniface Kiteme for continued support in my academic life and providing opportunities for research exposures and field works.

To my respondents, thank you for taking your time to give feedback in the oral interviews and questionnaires. Finally, I appreciate the University of Nairobi for according me the chance to pursue this course, my lecturers and my course mates for continued support and consultation throughout the course.

ABBREVIATIONS AND ACRONYMS

AIC	African Inland Church
EMCA	Environmental Management and Coordination Act
EU	European Union
GDP	Gross Domestic Product
KIMWASCO	Kiambere-Mwingi Water and Sanitation Company
KNBS	Kenya National Bureau of Statistics
LPG	Liquefied Petroleum Gas
MWI	Ministry of Water and Irrigation
NGO	Non-Governmental Organization
OECD	Organization for Economic Co-operation and Development
SDG	Sustainable Development Goals
TRDA	Tana River Development Authority
TARDA	Tana and Athi Rivers Development Authority
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UPC	Urban Project Concepts
WASREB	Water Services Regulatory Board

WRUA	Water Resource Users Associations
WSB	Water Service Board
WSD	Water Service Delivery
WSP	Water Service Providers
WSTF	Water Sector Trust Fund
WWDA	Water Works Development Agencies

ABSTRACT

The contributions of governance to water availability in Mwingi town. Identification of governance capacity to address issues of water scarcity in many parts of the world is pertinent and especially in urban areas characterized by high populations, high demand for water, high land rates, high capital generations, and low resources allocations and over-utilization. In areas with low water provision, governance intervention is key to create impetus environment for sustainable water provision. Mwingi town has rapidly growing population creating more water demand, which stands at 11,000m³ per day with only provision and supply of 2,700m³ by KIMWASCO. The study objectives address this scarcity. Water governance ranges from water management, water provision, supply and usage by the consumers. Areas with minimal water, either through natural or human provisions requires proper governance capacity to ensure continued supply of quality and quantity water. The objectives guiding the study are; (a) To investigate systems of water supply in Mwingi town, (b) To analyse the state of water governance in Mwingi town, (c) To proffer solutions to sustainable water reliability in Mwingi town. The literature underscored the water governance background by identifying water challenges, main actors of water in urban areas, the water provision and supply in the township with main water provider as KIMWASCO and identifying the demand and current supply, legal framework for water governance, the water governance structure and organogram, water governance issue and concerns in urban areas. The governance scarcity approaches with best practices anchored on factors of effectiveness, efficiency, and trust and engagement. The study uses governance issues as independent variable and water availability as the dependent variable, with human factors as mediating variable and natural factors as moderating factors. The systems theory is the overarching theory supported by sustainability theory, actor-network theory, collective action theory, and government as network model. The use of both primary and secondary data sources were used to gather information on study area and to inform the research exercise. Questionnaires as main primary data source were administered using the Kobo Collect tool and the statistical package for social sciences (SPSS) for data analysis. The study main findings are that the main source of water used in the town is KIMWASCO and the water vendors with a weekly water shortage for both households and hotels. The alternative water source included private boreholes, water kiosks, vendors and Tyaa River, with a bigger percentage of residents not harvesting rainwater. Some challenges encountered by water users include inadequate water, expensive water bills, salty water, and high transport costs. There are some measures for reducing water wastage like recycling water, educating employees, turning off water taps when not in use, and installing low flow showers. Many respondents expressed to lack knowhow on water policies and KIMWASCO faced challenges of low funding by the government, increasing water demand, which stresses supply, deteriorating and aging water infrastructure, high electricity bills, and low water supply from the source (Kiambere dam). The study concluded that for sustainable water provision in Mwingi town, governance actions are key. The insights of consumers on water shortages, scarcity, cost, connection, and quality issues will aid KIMWASCO and Kitui county government in addressing the concerns of water governance. To achieve the study focus on sustainable water solutions in Mwingi town the opportunities should be well utilized, and the raised governance issues and concerns addressed appropriately. This will mitigate all the water challenges on supply, distribution and provision in the township. This was by recommending some solutions to sustainable water supply in Mwingi town such as adequate funding of the water sector, water usage strategies to be maximally employed, involvement of public private partnership, quick response towards breakages and vandalism, provision of more alternative water sources, rainwater harvesting strategies, and formation of water committees to manage community water projects. The two main areas of further study included the effects of public private partnership in water provision in study area and water scarcity and pollution in the study area.

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CHAPTER ONE

1.0 INTRODUCTION.

Water is fundamental in realizing sustainable development comprising of achieving sustainable cities and poverty reduction. Utilization and misuse of exquisite water resources has deepened intensely over decades, getting to a point of water shortages, water quality deprivation and aquatic ecosystem obliteration, distressing prospects for economic and social development, political constancy and ecosystem integrity (UNDP, Human Development Report 2007/2008, 2007a). Presently, over a billion people have no access to water with over 2.4 billion lacking access to basic hygiene. In Africa, clean water access is lowest with Asia having prime number of occupants lacking access to sanitation. This water disaster emanates not necessarily from natural precincts of water supply or financial limitations or suitable technologies although they are imperative influencers but rather from reflective shortcomings in water governance (UNDP, Annual Report, 2007).

Water shortage implied as lack of access to adequate amounts of water for both human and environmental usages is progressively being acknowledged in many countries as a unyielding growing concern (White, Understanding water scarcity: Definitions and, 2012). The most frequently applied measure and quantification of water inadequacy is the 'Falkenmark indicator' or water stress index. The measure describes water shortage in terms of the total water resources accessible to region population by computing the aggregate of renewable freshwater that is obtainable for each person each year. If the amount of renewable water in a country is below 1,700 m³ per person per year, that country is considered to be experiencing water stress; below 1,000m³ it is said to be experiencing water scarcity; and below 500m³, total water scarcity, White, 2012

Water governance collectively relates to social, economic, political and operationalized administrative structures to improve and achieve water resources and the provision of water services at different levels of society (Rogers & Hall, 2003). Water governance consists of decision-making regulating systems concerned with water resources development and management. Governance applies political, economic and administrative powers in management of country's undertakings in all levels, comprising of the complex mechanisms and institutional processes through which people and groups express their welfares, intercede their differences, and exercise their lawful rights and responsibilities (UNDP, Governance for Sustainable Human Development, 1997). Water sector governance comprises formulation, institution and enactment of water policies, legislation and interpretation of the roles and responsibilities of government and its different levels, civil society and private sector in relation water resources and services. The results depend on how the participants act in relation to the rubrics and roles taken or allocated to them. The water sector is part of larger social, political and economic advances affected with resolutions by players outside of the sector. This necessitates the clarification on rights and governance of legislative provision by the bodies.

The efficient and operative supply of water services and tolerant realization as basic human right to water is achievable if doctrines of good governance guide management of the water sector institutions. In the established outlays of corporate bodies, good governance principles are engrained in tenets of corporate governance. Enhanced water governance is essential due to increasing water demand and successful access to water. Rapid economic development and collective variations increase pressure on water ecosystems. In many African regions, the needs outstrip supply to the degree that water resources are wholly allocated in all but the highest rainfall years.

Pollution is a major contributor to water scarcity and it intensifies demand for hygienic water. The access difficulties to water grow as creation of social, economic and institutionalized perspective as technical aspects governing water resources. Water forms the main economic activity and its even distribution in diversified patterns of demand and supply posters greater challenge than its absoluteness on the resource availability.

This study focuses on identifying water governance issues, specific causes of water scarcity, trends, encounters, management and knowledge gaps that are pertinent to improving sustainable water provision and controlling of water systems within the context of urban ecosystems. Water scarcity is a global issue and mostly in Sub-Saharan Africa, Arid and Semi-Arid areas. Governance issues of water includes funding, unaccounted for water, water rationing, impacts of water rationing to households, increase and decrease in consistent water supply. The identification of stakeholders/ actors involvement in water provision and supply will be pertinent to this research. This will give the base and direction for governance intervention through stakeholder participation and political precedence. Issues for instance political interference and unethical practices have a key bearing on design of infrastructure and the deliberate allocation of water for both domestic and productive purposes. Political interference and corrupt practices will not be discussed in this study because their intense and magnitude to the study are not measurable.

The systems of operative water governance are obligatory to ensure that all sectors of society have equitable, reliable and sustainable access to water. Enhanced water governance is important to realizing water security, reliability and access, fairly allocating water resources, and abating water related disputes. For this research, the terms “town” and “township” is used interchangeably to refer to the study area (Mwingi Town/Township).

1.1 Problem statement

The rising demand for water especially in urban areas creates necessity for proper interventions by all stakeholders and actors. Water is a rising distress in many parts of the world (Klobucista & Robinson, 2018). The situation worsens for urban areas in Arid and Semi-Arid regions. The areas have addressed adverse scarcity of water limiting the operations of urban areas by water access, adequacy and reliability. This limits effective running of urban growth, processes, activities and systems.

The water demand in Mwingi town stands at 11,000M³ per day, which is way beyond the supply of 2,700M³ of water per day (KIMWASCO 2021). The rapid population growth and inadequate governance capacity orchestrates the unmet demand for water, resulting to inadequate water supply in the town. The low and unevenly distributed rainfall with a mean annual of 300mm-350mm (Meteorological department Mwingi) decreases the natural water provision in the area. The status of water infrastructure is inadequate, minimally and irregularly maintained, which increases the unaccounted for water reducing the supply and quantities to the target consumption in the town. The unaccounted for water includes unmetered water for bulky and individualized water supply.

The local management committees for the water projects developed in town lack technical knowhow in handling and maintaining the projects. The committees develop leadership differences around financial management generated at the projects level. The committee collapses yearly, and it changes especially when there is a technical management issues.

The multiplicity of urban water governance by interplay of multiple stakeholder/actors create unclear responsibility in water management (Edelenbos & Meerkerk, 2013). Water actors includes the national government, county government, semi-autonomous government agencies and private provision.

This study evaluates sustainable water provision by analyzing the governance contributions through critically unpacking challenges and identifying all opportunities geared towards adequacy of water in Mwingi town. This will be through investigating various causes of water scarcity in the town to give a proper guide towards adopting efficient governance measures for water sustainability. The adoption of the recommendations in this study will improve water accessibility through enhanced governance.

1.2 Objectives of the Study

- a) To investigate systems of water supply in Mwingi town
- b) To analyse the state of water governance in Mwingi town.
- c) To proffer solutions to sustainable water reliability in Mwingi town.

1.3 Research Questions

- a) What are the systems of water supply in Mwingi town?
- b) What is the state of water governance in Mwingi town?
- c) What are the solutions to sustainable water reliability in Mwingi town

1.4 Research Assumption

It is assumed that water scarcity is an induced phenomenon, which can be adequately solved when all actors respond appropriately. The study assumed that the respondents will give correct information based on objectives and there is political willingness and adequate interests from the stakeholders. Water scarcity occurs because of natural inadequacy of water or human and socially induced factors.

1.5 Research Proposition

There is no clear interventions for governance capacity through KiMWASCO to provide water to the residents, and handling water provision, supply and management in Mwingi town.

1.6 Significance of the study

This research aims to provide solutions of water scarcity through suggesting and recommending improved governance interventions to Mwingi town, county governments and more specifically water solutions to arid and semi-arid urban areas with similarity to Mwingi town.

The water scarcity and the need for sustainable water access solutions prompted the research and hence it will give findings and recommendations in line with water sustainability in Mwingi town.

The research findings will hopefully lead to government capacity, institutions, community and individuals to adopt the measures towards sustainable water provision and supply in the town.

Urban water systems are critical infrastructure (water reticulation system) that support residents, businesses, industries, schools and landscapes.

The role and contribution of institutional water governance geared towards water equity in the town was critically analyzed, achievable through unpacking all the performers involved in water provision, management and supply to suggest and recommend adequate measures for governance capacity to minimize scarcity.

This study intends to benefit the national government and county government in streamlining the key issues raised within the area of study. The adoption of recommendations given will enable the government to understand the core of the scarcity and challenges and then develop solutions/mechanisms. The Mwingi town residents will benefit a lot from the findings, and hopeful adoption

of suggestions and recommendations in this study. The residents forms the basis of data collection and they are end users of the water resource.

The study will be useful to KiMWASCO as the primary water providers in Mwingi town. It will enable the identification of governance gaps provided by the study suggestions and recommendations. The academia will benefit from the study because it contributes to the body of knowledge and addresses the existing research gap.

Understanding the water governance and management structure in Kenya and roles of different institutions will help in recognizing various gaps in policy implementation. This will aid the national government and county government to synchronize the laws and policies to guarantee efficient water governance in the towns.

1.7 The study scope

1.7.1 Geographical scope

The study is based in Mwingi municipality and categorically Mwingi township area due to population and high water demand. The municipality has similar water conditions to the township area, therefore the research findings translate to effect water governance in the municipality. It will enable the analysis of challenges through a wider scope hence give a base for generalization. The interventions proposed and recommendation suggested have a broader application to areas with similar water conditions to Mwingi town.

1.7.2 Theoretical scope

The theories underpinning the study are limited to systems theory as overarching theory, supported by Actor-Network theory and Sustainability theory, collective action theory, and government as network model.

1.7.3 Methodological scope

The study is qualitative in nature and the research sample comprised 392 respondents. (369 structured questionnaires and 23 interview schedules for key informants) distributed as follows, 244 residential households, 30 hotels and restaurants, 65 commercial premises and 30 for industrial use. These are the water consumers and determines the demand for water. It will also include key informant interviews for KiMWASCO, Mwingi Municipality, and Ministry of water and irrigation Kitui County, who have been actively participated in water provision and governance in the town. The study will also involve water vendors, private water suppliers and community based organization responsible for water. This provides water to the households without water connections and during drought and dry-spell periods.

1.8 Justification

Water is pertinent and imperative commodity in which most of activities depend. In urban areas, water serves the uses of domestic, agriculture, industries, commercial and construction and in balancing the urban ecosystems. In areas with less rainfall and unclear ways of water access there is a need for research to bridge the gap and unpack sustainable ways to water access, suitability and sustainability.

This study will provide sustainable water solutions in Mwingi Town and areas of similarity to study area. The adoption of study recommendations and suggestions will provide a way out for water scarcity in the area. It will contribute to the body of knowledge by providing reference for similar works in Mwingi or any other place where issues of governance on what are not well articulated. This is by giving clear interventions on roles for each water sector.

1.9 Limitations

Inadequate technical information is a limitation because of the limited studies on urban water governance in Mwingi town. The Mwingi municipality area is wide for the study because the period and other resources required the study engaged only Mwingi township area.

1.10 Delimitations and exclusions

This study will only cover area within the town and not the entire Mwingi municipality. It will also study governance issues in relation to water for the township area and only concepts covered under study objectives will be studied.

1.11 Definition of terms as used in the study

Governance; is the process of inter-relations through laws, norms and power of an organized society over social system and is executed by the government. It involves creation, effecting and enactment of activities backed by common goals of citizens and establishments with formal authority or policing power.

Urban systems is composition of population and households, economic activity, essential environmental facilities and urban development policy initiatives sectors.

Water Scarcity; is the water shortage or lack of safe water provisions to meet the needs of the humans. Uneven access, overexploitation and extreme use of water among different social groups triggers urban water scarcity resulting from population growth.

Ecosystem; is environmental space where flora and fauna as well as weather and landscape co-exist. It consists the interactions of all organisms and the physical environment.

Suitability; is the quality of being appropriate for a particular purpose or situation by giving essentiality in order to meet governing necessities and protect both fiscal institution and the clients.

Accessibility; is the practice of making undertakings and environments sensible, evocative and usable for as various people as possible.

Sustainability; is meeting the necessities of the present without compromising the capability of upcoming generations to meet their own needs, while considering a balance between economic growth, environmental care and social welfare.

Water governance; is a collection of political, organized and administrative rules, practices and procedures through which decisions are implemented and, stakeholders articulate their interests and are held accountable for water management.

Water vendor; is a person licensed by water services board and registered with area authorized water service provider. May acquire water from own borehole or source from an authorized service provider and sells in portable form to third parties in accordance with agreed regulations.

1.12 Organization of the study

The research study has six chapters.

Chapter 1 comprises of water governance introduction in urban areas, which entails explanation of water governance and scarcity in the town and cities around the globe and the country. The problem statement, research objectives, research questions these sections provide specifics of the problem description in the study area and the objectives which guided the study. It also has the research questions, emanating from the objectives.

Chapter 2 is review of literature covering global perception of urban water governance and scarcity dimensions considered in this study. The discussions of theoretical framework and its relation to the study. The conceptual framework is given to explain the variables and their relationship in this study.

Chapter 3 is research methodology; discussing the study research design. The discussion of instruments of data gathering, data analysis procedures and presentation techniques. It also includes the structure of household questionnaire and key informant interview schedule, which forms the data collection basis for the study.

Chapter 4 is situation analysis; describing the current situation and condition of water supply, accessibility and governance in the country and Mwingi town. This guides the study in identifying the areas of improvements and giving study objectives the relevance.

Chapter 5 presents findings, data analysis and presentation, data processing, interpretation and presentation in accordance with the study's objectives as well as the challenges faced in the data collection exercise.

Chapter 6 provides a summary of study findings grounded on the Research Objectives, conclusion and recommendations, and outlines areas of further study.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

The chapter presents the discussion of desktop and empirical literature, the theoretical reviews and a summary of the study variables as discussed in the conceptual framework and study gaps. The literature was reviewed from legal framework, existing water supply activities, journals, papers, reports, the internet and the past studies in the study field.

2.2 Background

Global water shortage results from supply and demand imbalance for water sources in geographical area. An insufficient water supply the harshest issue fronting the world's poorest countries, with populations enduring the burden of water scarcity. The supply in water-strained settings is the source of plentiful conflicts globally (Sidel & Levy, 2011). Governance letdowns are one of the significant reasons for unsustainable resources management in general, and precisely water management. Economic development frequently focuses on and leads to satisfying the needs of the human population at the environment (Vörösmarty et al. , 2010), (Pahl-Wostl et al., 2012). Governance systems characterized by high levels of dishonesty undermine water security, both for humans and environment.

Urban sustainability is a substantial concern because of increasing urbanization across the world (Rydin, 2010). By 2030, nearly 60% of the world's population will live in urban areas (UN-Habitat, Water and Sanitation, 2015). Urban areas are important to all facets of sustainable development (Rydin, 2010) and water is an essential factor to sustainable development (UNDESA, 2015).

This then implies that, as a critical concern of the century, fresh and reliable water supply is critical for urban sustainability. Projection is that, by the year 2050 there will be less water obtainable for cities across the world (Pew, September 2017).

In Kenya, urban population for 2021 was 15, 667,076 a 4.08% upsurge from 2020. By 2050, Kenya's urban population prediction is 44 million people, making close to half, 46%, of the total country population, from predictable current urban population of 15.6 million people. (UN-Habitat, Annual Report, 2021). This requires the capacity for governance to provide all urban services in which water is key. The appetite to acquire urban life and access to better facilities stresses urban resources due to robust urban population growth.

In efforts to rationalize and increase water access and equity, Kenya improved the water sector in the 1990s to advance the performance of the water supply. The adjustment in institutions and organizations of policy and regulation, supply and consumption levels describes a specific governance model in the country. The reforms affected different water service delivery (WSD) categories by developing regulatory frameworks at policy and regulation level. In terms of provision, the transformation of Kenya municipal water services into public corporations and developed commercialization methods to increase cost recovery. The introduction of participation by users at consumption level to embrace customer-care strategies from suppliers (GII, 2011).

The water scarcity condition has exacerbated in most developing countries due to rapid population growth, economic development and urbanization, which has made it so hard to address the issues as well as providing sufficient sanitation services. A country's definition of water-stress measure is the per capita water availability below 1700m³ per year. Kenya is among the water scarce countries across the world with per capita availability below 1000m³ yearly.

Kenya's urban population growth and rapidly urbanizing rural areas increase domestic water demand, both for industrial and agricultural uses. Water scarcity is a priority to achieve the 2030 agenda, requiring adequate capacity to provide suitable and reliable water for all. The growing rate of wastewater production with insufficient treatment resources and inadequate systems has led to effluent discharge into river systems. Population growth exacerbates imbalance between water demand and supply in the country creating a state of water calamity to the people hence incapable of meeting their water needs. Enactment of policy framework however enhances resource management.

In Mwingi town, the urban population covered by individual piped water connection from a treated source stands at 35% (KiMWASCO 2021). Water governance is pertinent to water security and to the long-term sustainability of freshwater (Bakker & Morinville, 2013). The encounters of water governance are severe in developing countries (Araral & Wang, 2013). The strength of legal institutions supports sustainable use of natural resources like water in developing nations. Local institutions are greatly dynamic and they develop with society according to resident needs by fostering contribution in water governance.

The research exploration of water governance issues and concerns borrow from challenges of water supply addressed through the available opportunities, which in turn will give sustainable solutions to water reliability in Mwingi town.

2.3 Urban Water Actors

Ministry of water and irrigation (MWI); it has general coordination of the water sector, setting policies and legislations, and obtaining funds. Water services regulatory board (WASREB); approving the operators (WSP) that are selected and regulating tariffs. This is the level of policy and regulation. The ministry has five departments; Administration and support services, Water

services, Water resources management, Irrigation, Drainage and water storage, and Land reclamation. Water services providers (WSPs); operating and maintain the systems and providing water and sanitation services. Municipality owner of the WSP. Water service providers are corporate public utilities. This is the level of provision.

Users; active paying recipients of water. They form the consumption level. They are the households, hotels, industries, government entities and other uncategorized water users. Private water providers; they act in capacity to provide water to bridge the consumption gaps. They are profit oriented and the involvement in water production and supply is purely for profit motive. Water vendors; they source the water for the users and especially from water kiosks or rivers. They are mostly useful during dry-spell times when water scarcity is severe. Urban WSPs provide water services in urban areas and they operate under formal regulation by WASREB, which is able to track and report on these WSPs.

2.4 Water Supply and Provision in Mwingi

In 1974, an Act of parliament CAP 443 of laws of Kenya established the Tana River Development Authority (TRDA). It has the responsibility of incorporating integrated planning and coordination of all development projects within Tana River Basin and specifically to implement any projects for the purpose of utilization and protection of water and soils of the area (TARDA, www.tarda.go.ke, 2021). In 1981, the mandate extension included the Athi river basin, widening the scope to Tana and Athi Rivers Development Authority (TARDA) and comprised of multipurpose reservoir development approach. The authority's emphasis included; hydropower generation, environmental protection, natural resource planning and management, economic development for rural areas to lessen regional inequalities.

TARDA has since 2013 to 2021 implemented the thirty small dam/pans and smallholder irrigation schemes across Athi basin covering five counties (Makueni, Kajiado, Machakos, Kiambu and Kitui). The implementation of the projects has improved social economic status of the people in line with economic stimulus programme in the regions besides contributing to the big four agenda mainly food and nutrition thereby contributing to the achievement of 15% GDP by 2022 (TARDA, <https://tarda.go.ke/>, 2004).

TARDA had the mandate of developing the water infrastructure including laying pipes, stop-over tanks, construction of water reservoirs, connection and distribution of water from Kiambere dam to Mwingi town. Kiambere-Mwingi Water & Sanitation Company (KIMWASCO) is a limited liability company crated under CAP 486 of the Companies Act. It was incorporated in May 2009 after transfer of ownership of Kiambere-Mwingi Water project assets to Tanathi Water Services Board as per requirement of the Water Act 2002. KIMWASCO is mandated to provide portable water and basic sanitation services to the greater Mwingi region. The company currently produce 2,700 m³ of water per day and serves mainly Mwingi town and shopping centers along a 54km distribution pipeline that begin at Kyoea hill and ends at Mwingi town. The treatment works are situated at Kiambere which is 66 km north-west from Mwingi town. KIMWASCO currently has 4,500 water connections and serves approximately 60,000 (18%) of the population in its service area. TARDA is mandated to protect the water catchment areas. The existing water infrastructure in Mwingi town was commissioned in 1999 under TARDA. Currently, Tanathi is tasked with development of water assets in the areas of jurisdiction (Kitui, Kajiado, Machakos and Makueni counties). KiMWASCO is bestowed with capacity to take care of water infrastructure, water supply and provision in Mwingi town.

2.5 Legal Framework for Water Governance

2.5.1 Water Act, 2016

The act is responsible for regulation, management and development of water resources and sewerage services as mandated by constitution. The guidelines enunciation is in articles 10, 43, 60 and 232. It established the WRA, NWWSA, WSRB, WSTF and WT. The act describes ownership of and privileges in water resources of Kenya. It plays obligatory role as an agent for national government to control use of resources. This designate national public water works which include a) water storage; b) water works for bulk supply of water services; c) inter-basin water transfer facilities and d) reservoirs for impounding surface run-off and for regulating stream flows to synchronize them with water demand patterns, which are of national significance.

The act categorizes that every Kenyan is entitled to hygienic water in appropriate quantities and to quality standards of sanitation. The cabinet secretary shall formulate every five years a Water Service Strategy and establish one or more waterworks development agencies. County government shall institute water services providers as defined by the act. The act additionally provides for control of trade effluent, expropriation of land, administration and functions of the water sector trust fund, control of the water tribunal, and abstraction of ground water and respective works. The act created the following institutional framework for water services sector.

- a) The ministry of water and sanitation mandated to make policy.
- b) The county governments possesses and creates all the water service providers
- c) The water services regulatory board (WASREB) holds its name and regulates water services with a obligation of setting national standards for water service provision for consumer protection and licensing WSPs.

d) The Water Services Boards (WSBs) transform to water works development agencies (WWDAs) as mandate to county governments to develop national public water services works.

This boards are;

- i) Athi Water Services Board
- ii) Tana Water Services Board
- iii) Northern Water Services Board
- iv) Rift Valley Water Services Board
- v) Coast Water Services Board
- vi) Lake Victoria North Water Services Board
- vii) Lake Victoria South Water Services Board
- viii) Tanathi Water Services Board.

e) Prevailing service providers in section 154 remain functional to serve as county water service providers mandated to provide water services with specified licensed areas and assets development as set out in section 78.

f) Authorization of NWWSA to undertake water infrastructure development for public water and floor control in equal capacity to national government.

g) Mandate of WSTF to work in partnership with county governments and WRAs for service provision to scarce areas and managing catchments. Mobilization of fiscal resources was prerogative of WSTF from private investors and ongoing advances to creditworthy and research promotion in areas with water catchments. Its fundamental obligation is financial aid to develop areas sidelined areas.

h) The water tribunal serve as court for hearing and possible determination of consumer appeals affected by verdict. The tribunal has mandate to resolve water related disputes in the country.

2.5.2 The Constitution of Kenya 2010

The following constitutional alterations were introduced in governance structure.

- a) Domiciling the article 2 on international law to be part of Kenyan law.
- b) Supremacy of devolution with objective to improve service delivery and elaborate role on article 6.
- c) National government on significance of water sector as public engagement tool in article 10.
- d) Prerequisite legislative role on policy methods for setting standards achieving advanced realization of clean water rights with admirable sanitation quality in article 21(2).
- e) Rights and privilege to hygienic water with adequate amounts and sound sanitation standards in article 43(1).
- f) Customer rights to quality facilities, information, full benefits of economic interests in article 46.
- g) Following is apportioned in Fourth schedule in constitution
 - i. International use of water resources for ecological preservation in compliance with natural resources. This is establishes long lasting and sustainable development trends in water systems. The role to national government.
 - ii. Implementing precise national regulations on natural resources for soil and water. The role for county government.

2.5.3 The County Governments Act, 2012

The county government has mandate to manage the resources within their jurisdiction. Control of water and natural resources are within confines of county government operations. Water catchment areas management is under the county government.

2.5.4 The Environmental Management and Coordination Act, 1999

It relates to water conservation, protection, and water pollution control. It provides the formation of the national environment council, environment management authority and national environment trust fund. It controls matters in relation to the institutions recognized and various matters relating to environmental protection comprising environmental audits and monitoring. The authority's purpose is executing overall supervisory role and policy implementation in relation to environment. The EMCA regulates the activities on environment and controls pollution. Water catchment areas protection are anchored in EMCA through National Environmental and Management Authority.

2.6 Water Governance Structure and Organogram in Kenya

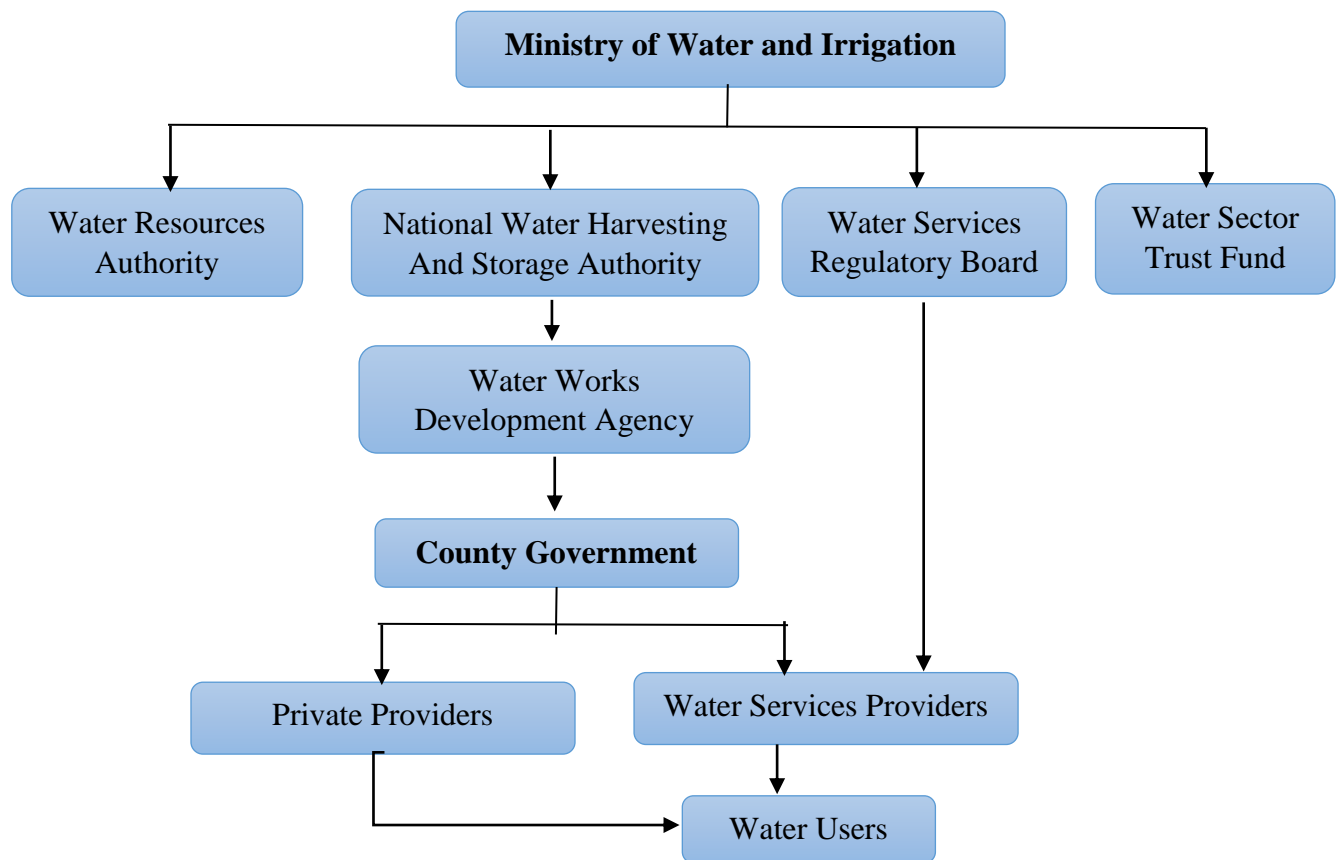


Figure 1; Water Governance Structure and Organogram in Kenya

Source: Author 2023.

2.7 Urban Water Governance Issues and Challenges

Water governance is a disastrous concern in developing countries because of improper implementation of guidelines in governance systems (Remmert, 2016). Poor coordination of units dealing with storm water, water supply with hygienic provisions lessening governance intervention. The need for administrative and statutory changes to minimize sector constraint in interpreting the support strategy (Vairavamoorthy & Bahri, 2015).

Rapid and unplanned urbanization: for towns in developing countries there is strain in preparation and accommodating current populations leading to proliferation. This exacerbates the disparity by creating difficulty in delivering key services. There is rise for infrastructural demand to connect the unplanned dwelling with rest of the ecosystems in desire to get services resulting to undesired densities and congestions. The ability of water resources to respond and effectively distribute water becomes a challenge in both quality and quantity because all is under strain due to intensifying water demand and deficiency.

Water scarcity: water supply and management, water deficiencies create difficulty in acquisition due to lack of new backgrounds that are cost-effective for bulky urban areas in underdeveloped countries.

Insufficient capital investment: to control and keep existing water systems and infrastructure in urban areas, proper and ready funding is necessary. Insufficient funding curbs the operation and upkeep of current water services and development (Biswas, 2006). Pertinent financial approach is required and relevant for the water systems and infrastructure maintenance for continued water supply, on and out of season.

Leadership issues and conflicts: the wrangles develop at committee levels bestowed with responsibility of water project management. Whenever the projects face a serious technical problem, the committee collapses. Most conflicts revolve around financial management and project causing division among committee members on how to spend the money. The projects then lack maintenance capital requiring the government to channel the funds for same projects.

Ineffective management of water, urban water control practices are context specific without obligatory extents towards addressing mandatory issues related to water and facing towns in developing world. Urban water management and service delivery of many urban services lack organizational disposition. Insufficient capacity to manage poses a major scarcity cause, hindering effective performance. Unpleasant pay coupled with periodic political interference cause meagre administration in process of decision-making towards water management.

Deteriorating and Ageing Infrastructure this increases the water losses through unaccounted for water and hinders effective water delivery to targeted populations. It forms platform for urban water systems for storing, supply and distribution. In most African countries, the infrastructure is nearing or exceeds the planned lifetime. The water infrastructure lack sufficient attention for replacement and protection because of lack of routine maintenance, insufficient investment information and insufficient capacity for decision support systems.

2.8 Water Financing in Kenya

The creation of water fund as a statutory establishment in ministry of water, sanitation and irrigation. It was operationalized under Water Act, 2016, with authorization to deliver grants to counties as well as assisting in financing water projects. The water fund has mandate to undertake following programmes;

- a) Urban Investments – established through urban projects in 2007 to attend explicit hygienic (water and sanitation) concerns of urban poor in Kenya. The areas experience mixture informal settlements coupled with unplanned developments. They are characterized by inadequate hygienic conditions. This program aims to improve the water and sanitation in low-income urban areas. Since 2008 the EU espoused with German development bank facilitate finances to this programme. Nevertheless, it has faced challenges of inadequate funds, slow implementation and misappropriation of funds.
- b) Rural Investments – supports implementation of water supply and sanitation developments for underserved rural communities. It is the pioneer funding mechanism at WSTF and began financing projects in late 2005. The key implementers are community-based organizations and increasingly water utilities who are involved in the preparation, planning, implementation and sustainability of their own projects. The programme relies upon outsourced support services from the private sector to offer technical support while the county governments assure coordination and supervisory roles.
- c) Water resources investments – launched in 2008, encouraged by fact that a big part of the population was not connected to water linkage, making dependence on normal water resources inevitable. Support to communities to successfully manage and preserve their water resources within their sub-catchments. It presently has three programmes funded by the governments of Finland and Sweden, the international fund for agricultural development (IFAD), and Denmark (DANIDA). The Kenyan government covers operational expenses of the water fund while other funds support the development of project depending on the funding bargains of specific partners.

d) Result Based Financing – support for water and sanitation projects in urban low-income areas, sponsored through commercial loans subsidized on attainment of agreed outcomes. This investment programme is a commercial financing facility that became operational in WSTF in December 2014 after the government of Kenya signed an endowment subsidiary agreement with the German development fund and the World Bank. In appreciation of the need to lessen grant financing for commercially feasible water utilities and in order to introduce a new business model to water financing, the RBF programme is supporting water utilities that are investing in water supply and sanitation improvement projects in the low-income and underserved rural and urban areas in Kenya. The WSPs are able to influence loans from local financing institutions, subsidized at a percentage of the project cost on attainment of agreed deliverables.

2.9 Water Governance Approaches for Scarcity

Water governance comprises safeguarding the policies, strategies and legislations with water services providers to develop and manage water resources in competent and effective manner while being accountable to the beneficiaries of the services. The approaches and practices include for Kenya, China, Jordan city, Cape Town and California. Dublin in Ireland and Netherlands with best practices for scarcity approach and water governance practices.

2.9.1 Water Governance and Management in Kenya

Water provision services and water resources management in Kenya is a common responsibility between national government and local authorities of major urban centers, the latter concentrating on services for their respective urban centers. Formation of the Ministry of Agriculture was in 1974. The National Water and Pipeline Corporation was created as public corporate body under state corporates act (Cap 446) in 1988 mandated to take over a number of existing water projects and supply water in bulk to people. The water services and resources management remained regulated by Water Act 1952 until 2002, which established

semi-independent institutions with clear authority lines. The reforms resulted to; (a) Separation of policy and regulation from implementation. (b) Provision of an enabling environment for privatization and creating efficient service oriented structures in public functions. (c) Decentralization of water management and services to regional bodies i.e., Water Works Development Agencies-WWDAs and communities. (d) formation of various autonomous institutions (WRA, WASREB, WSTF and WSPs) carved out of the various functions which the parent ministry provided, leaving the ministry with strategic preparation, sector organization, guidance, monitoring and evaluation.,

The 2010 Kenyan constitution formed County governments under principles of devolution with shared duties as state government for the delivery of water services and resources management. This stated provision of clean water as social right. In a distinctive role, the duty allocation for the national and county government are provided in fourth schedule of Kenyan constitution 2010. The functions under state government include water security, sufficient residual water, hydraulic engineering and safety of dams. Those under county governments include soil and water conservation, water and sanitation services, and management services of storm water in constructed areas.

WASREB formation in 2003 under water act 2002 and retained in water act 2016. It is mandated to supervise the implementation of regulations relating to provision of water and sewerage. It monitors and routinely accounts on the performance of utilities, water works development agencies and counties. It sets, observes and reviews the relevant policies to ensure water supply is affordable, efficient, effective and equitable. During dry spell periods some coping mechanisms by households embrace; water storage, construction of substitute water sources, water borrowing from social networks, buying water from private vendors, water management and reuse, illegal connections to public water networks, water garnering, fetching water from distant sources, and water treatment to advance the quality.

2.9.2 Asian Practices: China

Asian water inadequacies for stress and scarcity are developing as a major social and economic menace, particularly in China and India. In China, although freshwater is plentiful, the distribution is uneven and hence inaccessible to many country regions. China is the world's prime producer of rice, which is water-hungry crop, yet it is fronting a extreme water disaster. China dries yearly and its freshwater reserves deteriorate 13% between 2000 and 2009. Severe famines transpired in 2000 through 2009.

Beijing, Northern and Eastern regions had severe drought in 60 years, leaving 2.57 million people and 2.79 million livestock without water. South China faced 50% less unusual rainfall resulting in drying up of rivers and reservoirs. Over 300 million individuals in countryside lack access to hygienic water, 54% of major rivers in China have water unfit for human consumption (Brown, 2010). Increased population in China's urban areas increased the country's water needs from 599 to 630 billion cubic meters by 2020. Water uses in China mainly include agriculture and hydropower production. Water recycling as a mechanism to curb water crisis is 75% in China. This includes wastewater, surface runoffs and grey water. Through conservation and efficiency mechanisms, the Chinese governance is in efforts to increase water supply and control demand. China leadership has engaged 21 million acres of land since 1998 out of production and farmers essentially practice water retaining irrigation practices, which reduce agricultural water use from 83% to 60% for a period of ten years. Throughout southwest China, farmers engage in plastic sheeting programme around crops to collect rainwater that flows into the land minimizing loss of water.

Industrial water preservation through a advanced system of water rights transmissions in arid areas of Mongolia and Ningxia. Farmers receive payments by coal industry for promotion of irrigation

techniques that save water for its use. Chinese investment in renewables like wind, solar and coolant using seawater replaces 100 coal plants preserving 3.5 billion cubic meters of water annually (Renee Cho, May 5, 2011). The adoption of stern water resources policies calls for 30% reduction in use of water for each dollar of industrial output, with a goal to minimize water pollution by 8% by 2015, by putting a threshold on total water use in river basins. China stress to strengthen law enforcement, rationalize and harmonize water institutions by establishing clear water rights and fines. The recommendation was use of water trading rights and pricing to control demand, making information accessible to public for increased public engagement. China is on its way towards overhauling institutional policy framework to realize the world leadership in water resource management.

Water Governance in China.

The analysis done in the perspectives of quantity, quality and service. The examination of current systems shortcomings earmarks water resources and accomplishes water quality through a top-down method depended on centralized political mechanisms identified as the important cause of the country's water hitches.

The difficulties analysis faced by the Chinese government in market improvements of the water service sector have occurs because of top down methodology. The problems of prolonged drought and deficiencies of water are serious in rivers Huang, Huaihe and Haihe located in northern China a region identified by illogicalities in terms of water provision. Improved cognizance of water rights plays imperative role in monitoring and limiting inappropriate government actions. It is also a significant step towards severe restriction by existing power hierarchy resulting from license system.

Governance of Water Services; Regulation Framework

The governance of water services in China services holds multiple aspects of planned economy since the organization do not uphold even supervision and management over water services. Currently the department of local water resources is obligated to undertake water projects and the municipal oversees the supply, and the departments work independently for the roles assigned. The semi-autonomous agencies practice power to collect fees and has approval rights. The alteration of industrial operative model in towns of Beijing, Shanghai and Shenzhen. The establishment of water amenity group and urban water supply to administer the industry operations formed water service structure.

Water prices; public services set water charge using the “cost-plus-yield rate’ method. The key motive behind rising cost in water supply and distribution enterprises relates to lack of an suitable accounting system meaning costs oversight is assumed. The official introduction of price hearing system by Chinese government enhanced public participation in price setting, but residents are largely reluctant to pay due to frequent inflations of water prices.

Market reform; numerous government sectors have introduced limitations on foreign and nongovernmental capital for advancing the efficiency of infrastructure and public utilities particularly to lower financial liability on the state. The problem origin persist because water industry is not market oriented with adoption of dominated operations from planned economy stage. The advantage of private sector provision is that there is direct interaction with customers assisting water companies to observe market demands, undertake supply-oriented production and minimize resource wastage. China’s water governance is rooted in top down approach under state ownership of water.

2.9.3 Jordan City Approaches and Practices

Water scarcity is certain in Jordan because country is among the world's greatest arid countries. The situation exacerbates due to immigration of expatriates to the Syrian catastrophe. Currently the country's water supply is 200m³ annually making almost a third of worldwide average. Jordan is increasing substitutions to water supply comprising of desalination of seawater and recycling of wastewater. Desalination offers hygienic water to areas fronting adverse water shortages and helps in conflict resolution for urban and agricultural water necessities and providing a new autonomous water source.

In efforts to counter water shortage Jordan encourages recycling and reuse of municipal wastewater as an appealing mechanism to save water. Treated wastewater reuse has extended the highest levels worldwide. Marshlands construction and artificial lakes serve as storage facilities are able to collect and hold rainwater with multiple use for dry spell season. For effective and maximum water retention, the reservoirs are sheltered in special way to allow air in or installation of floating solar panels on top on reservoirs to reduce evaporation and generate clean energy. The proper incorporation of improved irrigation techniques and crop selection with appropriate water practices minimizes water loss and enhance irrigation productivity.

2.9.4 California City Approaches and Practices

California is a city in United States of America receiving plentiful amounts of rainfall averaging 38 inches annually, but it has received a number of droughts especially 2019. The government regulated use of residents by ensuring an average of 55 gallons daily which is adequate for filling bathtub and flushing toilet. During 2019 dry season, it received less rains requiring the residents to minimize water use by 15% an objective to be compulsory if residents fail to comply. They have

created drought resilience through appropriate planning and re-engineering systems that retain water flow in dry places.

By order, Californians expurgated their water needs and use by 25% countrywide. There is lack of statewide alternative, general mandate and homogenous wastewater legislations. The urban hubs organize to weather the summer with pro-bono cuts and limitations acting as holdovers from preceding droughts.

2.9.5 South Africa, Cape Town

The declaration of Cape Town water crisis in 2018 as national emergency was due to prolonged drought becoming the first city to go short of drinkable water in the world. This was the worst ever experienced drought in the history of the town on record. The city was edged towards Day Zero the situation where municipal water provision nearly shut off. Theewaterskloof dam as the major supply of water remarkably increased dam levels from 11% on March 9, 2018, to 90% on October 2, 2020. The 2019 rainfall was crucial in enhancement and city's management strategies but public water struggles played big role. The reuse of water and imposing limits on undertakings that need huge quantities of resource the inhabitants managed to stabilize the calamitous condition. Some mechanisms taken to evade Day Zero in Cape Town include,

Re-allocating water, instantaneous reaction to water shortage the authority-diverted water from agricultural sector to supply the city. It was not viable solution as water for farming was in little supply, it aided the management to buy time for crisis response.

Residents and businesses became water wise by drastically realigning water needs, supply priority by adopting new practices, and developed resourceful in sourcing water. Residents were restricted to use 50 litres per residence daily. To flush a toilet 10 litres of water is needed leading to

monitoring for use and reuse of water, prohibiting activities that require undue amounts of water. Pools went unfilled and cars without washing and gardens watered at night to reduce evaporation. Increasing water cost, rolling out 250,000 water management devices (WMD) and setting restrictions on utilization of water in properties. The devices displaced outmoded water meters and automated to mute property's water provision upon reaching daily edge. Households with high volumes of water usage and surpassing confines faced punitive fines. Provisionally the municipality amplified water rates to discourage extreme use of water for households. Criticism of financial measures for unethically affecting poorer inhabitants. Water management resolutions on diverse inhabitants installed 64% of WMD's in impoverished communities with high water usage this was according to 2018 report, Cape Town. To reduce future scarcities in Cape Town the municipality resolved to grey infrastructure and green solutions. These measures include desalination, recycling wastewater and tapping groundwater supplies. Green resolutions prospectively produce substantial water supply upgrading at minor cost. The water fund was established and public-private corporation that connect around common goal, spending nature-based resolutions to enhance sustainable watershed management. Downstream consumers such as businesses and utilities contribute to upstream continuance initiatives for successful water quality and quantity for the area.

The desirous invasive plants like acacia and eucalyptus draw up enormous amounts of water reducing amount accessible for Cape Town residents. The alien plant invasions are taking up 55.4 billion litres of water annually quantity that can supply the city and its environs for two months, for regions with less water the losses are substantial.

Establishment of Cape Town Water Committee to work in consultation with relevant shareholders for reestablishment strategy sub-catchments acknowledged as significance for water supply. With

an investment of \$25.5m dollars, commission assist in creating enabling water-secure impending for Cape Town.

2.10 Best Practices of Water Governance

The dimensions anchoring principles are effectiveness, efficiency, trust and engagement. **Effectiveness** relates to involvement of authority to define clear bearable water policy goals at diverse levels of government for policy execution.

Efficiency recounts to contribution of governance in exploitation and profits of sustainable management.

Trust and engagement relate to input of government in developing public confidence and extensiveness through representative legitimacy.

2.10.1 Water Governance in Netherlands

The composition of 21 regional water establishments managing water systems to uphold levels, quality and treatment of water. Decentralized water authorities for public authorization for endowed specific lawful personality and capitals (OECD, Principles on Water Governance, 2014 (3)). Organizational agreement on water matters signed in 2011 in Netherlands between ministry of water and infrastructure. It promotes efficacy across water chain to EUR 750m annually until 2020 through enhanced partnership and reallocation of duties (OECD, Principles on Water Governance, 2015(4)). Decentralization of water regulations has resulted in assigning progressively composite and resource-intensive capabilities to local governments.

Water management

The water boards also called stakeholder democracies because different groups of interest contribute in the decision-making procedure. The governance system has been practically present

from the beginning of Dutch water management. The water boards are based on the principle of interest-pay-say, which means that whoever is interested in the decision making process must pay for water. Additionally, this institution has different participants' involved creating decision-making process based on the consensus between the different leaders and the authority (Lulofs, 2007).

Water boards are composed of three elements to form a governmental body, a water board assembly, an executive assembly and a president. The assembly is conformed by different representatives from diverse actors interested in the water board activities. Its main task is to regulate and promote the annual accountability, such as taxes, tariffs, registers and regulations. The executive assembly consists of a president and other members assigned by the assembly and its main job is to manage daily activities. It has five members with the capacity to plan policies and carry out different actions. The crown elects the president for six-year period, who represents board, can sign official documents, initiate some measures, and has an accountability responsibility with the assembly (Lazaroms & Poos, January, 2004). This decision making process has proved to be quite effective in Netherlands and one of the most important proofs is the absence of water catastrophes in the last 50 years. The council creates openness and consultation with various parties during the implementation of policies and water works, for instances, municipalities, farmers associations, the regional authorities, citizen groups, industry associations and environmental and nature NGO's. it is framed to bring various parties together, both governments and other groups and organizations.

2.10.2 Water Governance in Dublin, Ireland

The Dublin population and its environs stands at 1.3 million projected to be 2.1 million in 2022. Presently authority process addresses predictable water supply discrepancy relies profoundly on a

combination of classifying new supply source to safe long-term water supply requirements of city composed of intense drive toward realizing reduced usage and preservation objectives in accordance with EU standards for numerous individual and sectoral consumers.

The enactment of a water governance improvement that gives explicit responsibilities to three levels of government. The first level is housing, planning and local government responsible for water policy and legislation. Secondly, environmental protection agency in charge of scientific investigation. Thirdly local authorities dealing with application and public engagement. A complex governance is grounded on sound coordination to minimize misalignments, convolution and overlaps for precise water functions. Water services are treated as basic public health requirement and potential limitation to growth of population hence source of land for development.

Water provision and wastewater services are fundamental concerns in urban planning process at both regional, city and county planning scale. Water services responsibility transferred from local authorities to a particular communal water utility (Kelly-Quinn, Blacklocke, & Bruen, Vol. 19, No. 4, Dec 2014).

The direct water and wastewater charges services to inland customers will use internal metering. Nondomestic consumers are charged based on metered consumption with set prices by local authorities. This is a grouping of a flat rates and a metered rate based on real volumes used. There is method to evaluate the full cost recovery for both nondomestic water and sewerage charges. Local authorities levy, once-off, expansion contribution in respect of municipal water infrastructure. The changes of public water facilities founded Irish water, which is public water utility, within board gas Eiermann group, regulating supply of drinkable water and management of wastewater services.

2.11 Variables

2.11.1 The Dependent and Independent variables.

The independent variable the manipulated or varied in study to discover the study effects, and not influenced by any other variable in the study. The dependent variable changes because of the independent variable manipulation. It is the resultant of interest measured in study and depends on the independent variable.

In this study water availability is dependent variable in which its effectiveness or failure is influenced by governance factors (independent variable) such as water institutions (framework), policy framework, and water infrastructure (reticulation system). Water availability is viewed from a spectrum of accessibility, affordability and suitability. The sustainable solutions for water reliability in Mwingi town will be highly influenced by the manipulation of governance issues and concerns in which failure will lead to persistent scarcity of water in the area.

2.11.2 The Moderating and Mediating variables.

The mediating variable elucidates process through which leading variables relate. Moderating variable affects both strength and direction of association. The human factors includes personal actions, water financing, water harvesting, pollution and climate change which mediates water availability and governance, hence is the mediating variable. The access to hygienic water is depended on individual's capacity to afford the water. The natural factors such as water resources, global warming determines extend of water availability. These determinants moderate the relationship between water availability and governance factors hence the moderating variable.

2.12 Theoretical framework

This study section discusses theoretical underpinnings. The study theoretical review undertakes the overarching theory as Systems Theory supported by the Sustainability theory, Actor-Network theory, collective action theory and government as network model as discussed below.

2.12.1 Systems theory

The theory is interdisciplinary applying to all systems in environment, society, and many scientific areas and structure for exploring events from a universal perspective (Capra F. , 1997). The systemic point of view argues that phenomenon cannot be fully comprehend unless breaking into elementary parts and reformation; instead, one must use global vision to highlight its functionality. The essential analysis of components is observed from an advanced level in order to appropriately appreciate it in its totality, a holistic viewpoint (Bertalanffy, 1968). This theoretical approach contemplates a phenomenon in its fullness rather than its pieces. To comprehend an entity's organization and operative the focus is on connections and relationships between pieces.

The theory usefulness in study recognizes water governance issues as an aggregate of policy framework, water infrastructure, human factor and natural factors, which holistically define water availability through demand and supply. The water governance issues should be handled from a common point of view because it acts as a system.

2.12.2 Sustainability theory

The introduction of sustainability concept was in relation to natural resources and their use. The natural resources are limited hence cannot sustain the world's predicted population with current levels of resource utilization and advancement. Sustainability embraces balancing free markets and human understanding capacities. Firstly, threats to sustainability mainly emanate from overpopulation and depletion, however second perspective outlines that sustainable threats

originate from poor policies (governance) by (Taylor, 1993). Sustainability is viewed as a broad concept, which not only limited to technology (Graham-Tomasi, 1991). By definition it is capability to maintain a certain flow over time from base upon which the flow depends and principally issue the intergenerational impartiality (Howarth & Norgaard, 1992).

It describes an economy and society lasting and living on global scale, and global production role in considering inter-generational justice. Sustainability is consequential prerogative to take social, economic and environmental policy thoughtful independently of any connection in time and space and striking balance between all aspects. Sustainability is viewed from the perspective of policy-making and diverse working fields for ultimate generational relations.

2.12.3 Collective Action Theory

The theory was introduced by Olson (1965) then popularized by Elinor Ostrom in *Governing the Commons* (Ostrom, 1990). It developed as a theory to elucidate why many societies using natural resources do not continuously experience overexploitation for instance common-pool resources and the tragedy of the commons (Hardin, 1968). Basing on governing the commons theory postulates a positive association between groups taking effective communal action and resulting social and environmental results. The theory purposes to comprehend how and why people collaborate through self-organization procedures and natural variables influence self-organization. The theory assesses the governance status by categorizing what variables may be qualifying or hindering self-organization procedures. In solving water scarcity and governance concerns, in relations to water sustainability it shows the role each stakeholder should take in collective manner and interdisciplinary way to create an enabling environment for water provision.

2.12.4 Actor-Network theory

It focuses on connections made and re-made in all entities that are part of subject at stake. This is done by investigating the contexts of underlying structures by tracing the connections through observation, document analysis and interviews. It examines the determinants that requires coordination to bring together actors from diverse spheres and with diverse interests (Callon, Latour, & Law, 2019). This is through contribution and limits to understand issues of participation, partnership and inter-sectoral cooperative in governance practice.

2.12.5 The Government as Network Model

The model proposes government as entwined system, a composite system of temporary relations shaped to solve problems ascending and linked by informal networks of communication. It intends to link, communicate and collaborate. Nevertheless, model is holographic for the parts function like entire, individual ventures function within web of consistent projects.

2.13 Research Gaps from the Literature Review

Related research studies undertaken in Kenya include a thesis project focusing on Sustainable urban water management; Mavoko municipality (Kaliti, 2022). It focused on water management practices where governance borrows a lot. Another study for corruption risks, management practices, and performance in water service delivery, a model-based study comparing Kenya and Ghana, did not explicitly deal with governance issues as it focused on corruption as a factor hindering water governance. The Urban water governance: a study done in Shillong, Meghalaya in India focused on examining role of traditional institutions but did not address water scarcity in relation to governance for towns in developing nations. Water related studies cover larger Mwingi with no specificity on water challenges and governance issues in Mwingi Township. The study addresses the identified research gaps with appropriateness to Mwingi town.

2.14 Conceptual Framework

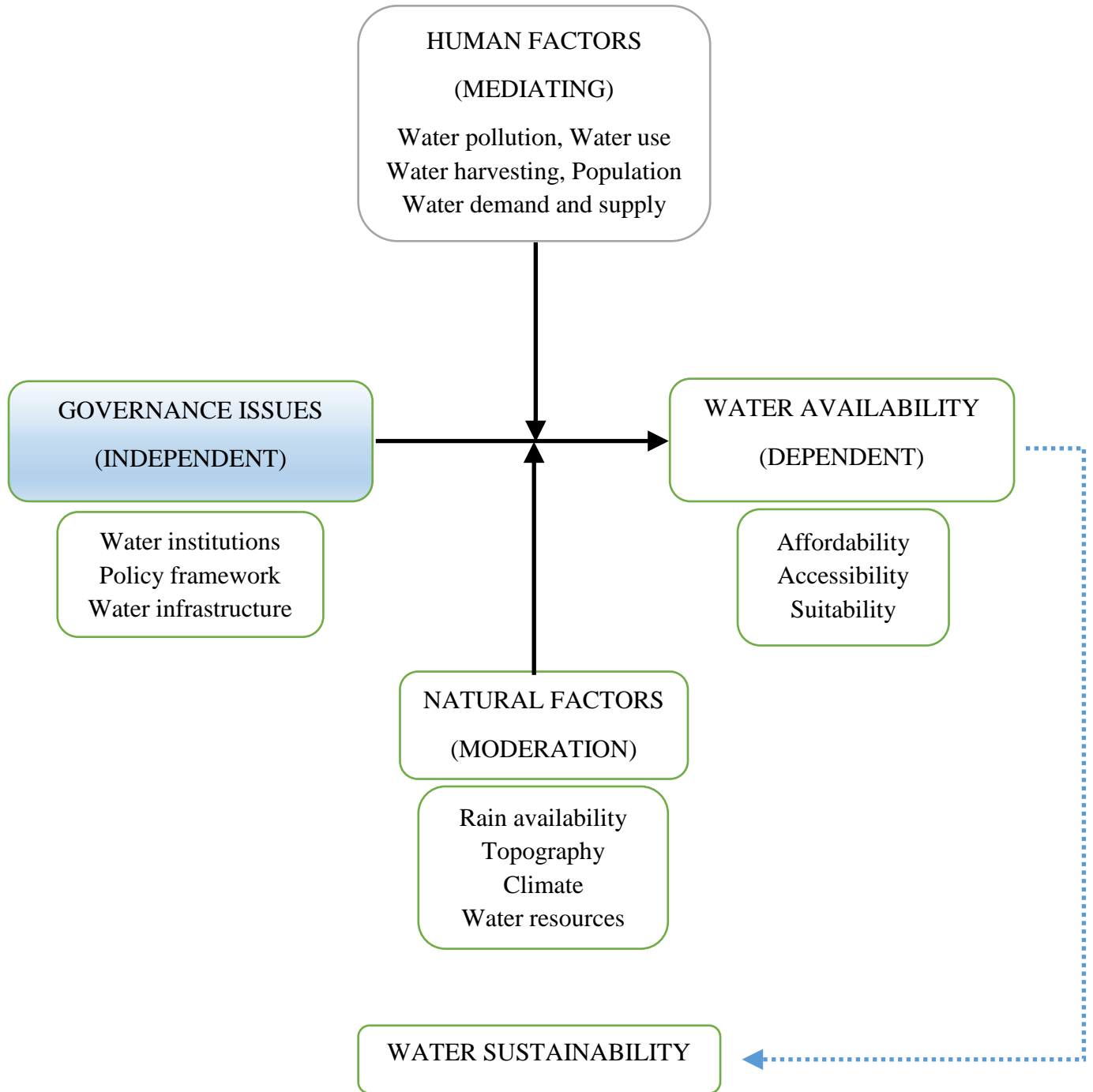


Figure 2 Conceptual Framework

Source: Author 2023.

CHAPTER THREE

3 RESEARCH METHODOLOGY

3.1 Introduction

The chapter describes the research methods and techniques used in the study. This include data gathering methods, data presentation and analysis, and study design. It discusses units of investigation, ethical issues, questionnaires, then methods reliability and validity.

3.2 Research Design

A research design forms a framework to define correlation between variables in study (Kothari, Research Methodology :: Methods and Techniques, 2012). This study holds a descriptive research approach using interviews, questionnaires and review of documents for accurate utilization and depiction pf certain setting. The study used this design because researcher needed to understand the status of water governance and supply conditions in Mwingi town. The selection enabled the researcher to comprehend conducts, characters, opinions and attitudes of accomplices towards use and conservation practices of water. Qualitative observations endorsed in-depth investigation and chance to certify present water governance conditions.

The study administered 392 structured questionnaires to households, commercial premises and industrials uses joined with literature review to realize set objectives. It used key informant interviews with KiMWASCO, Mwingi Municipality, Ministry of water and irrigation Kitui County.

3.3 Target Population

The study targeted households, enterprise and commercial activities in study area. This population gave information based on water supply because they form the market for water and hence they

are the consumers. The water service providers are KiMWASCO, water vendors/kiosks, and private water suppliers. This group gave information on water provision because they are the suppliers of water. The water regulatory bodies included water resource authority. The authority is responsible for making legislations to control water use and resources. The water governance respondents were water officer Kitui County and Mwingi municipality (department of environment), and ministry of water national government. This responded in line with the policy implementations towards water use and supply.

3.4 Sample Size and Sampling Procedure

A sample is a subset of population. It is proportion of total population that has been chosen to take part in the research effort (Polit & Hungler, 1999). The Mwingi municipality covers an approximate area of 88 square kilometers with a population of 108,823 people (52,527 men and 56,292 female, 4 intersex). Mwingi township area is approximately 3.5 square kilometers in size. It has a population of approximately 20,794 residents according to 2019 KNBS housing and population census. The research adopted random sampling for household surveys mainly targeting residents, commercial and industries. Application of Slovin's formula was used to compute the sample size.

$$n = \frac{N}{1+N(e)^2}$$

Where, n = is the sample size,

N = is the total population size,

e = is a margin of error/ error margin

A confidence level of 95% and assumed a precision of 0.05.

Basing on the formula, and using N as 20,794

$$n = \frac{20794}{1+20794(0.05)^2}$$

$$n = \frac{20794}{52.985}$$

$$n = 392$$

Therefore, a sample size of 392 respondents was used. The households and business questionnaires, interview schedules and semi-structured interviews was administered.

3.5 Data Collection Methods and Instruments

The research relied on both primary and secondary data sources to formulate findings. Gathering data from households was with help of two research assistants. Undertook training of research assistants and conducted piloting of data collection to help them fathom the questionnaire and study area before beginning on the task. The piloting abetted unnecessary effort from the researcher, research assistants and respondents, as well as indulgence of research resources.

3.5.1 Primary data sources

This involved findings collected through key informant interviews, administration of household questionnaires (households selected randomly) and field/participant observations/measurements and photography (interacting with real ground and getting information as it is). The data collection used digital questionnaires by Kobo collect tool. The questionnaires aided in collecting the data on water demand, consumption, supply levels, accessibility, affordability, suitability and sustainability. Water consumption levels and utility satisfaction were also determined through questionnaires. The household number determined the suitability levels for water demand and supply. The key informant interviews focus on the water providers. This focused on governance sector, water infrastructure, water financing, metering, and water consumption rates, unaccounted for water, water and source catchment management, water harvesting and challenges.

Gender promotes equality and combats discrimination against women and other marginalized groups. It enables to drive outcomes and study societal patterns to make wise decisions for guiding the research. Age is useful to determine the person's familiarity and experience about research topic. Understanding age composition produces insights to altering population conditions and identify upcoming social and economic trends. Populace growth rate strongly prejudice the extents of individuals of specific ages.

Marital status shapes the basis for analyzing demographic phenomena like changes in family structure. Household size has a direct associate with resources distribution. Water users information comprises of water supply services will give data on main water sources, household water connection, amount of water used, shortage experiences and alternative source of water, distance covered to acquire water, rainwater harvesting, water quality and quantity, water pricing, and mechanisms for minimizing water wastage.

3.5.2 Secondary data sources

The data with statistical examination after collection by the researcher (Kothari, Research Methodology, 2004). This study will include reviewing books, papers, magazines, newspaper articles, environmental reports, geological reports and survey maps as secondary data sources. The maps guided in identification of water systems and infrastructure on ground, and then determine conformity with land use.

3.6 Reliability and Validity

Questionnaire's validity and reliability appropriation ensures that the instrument provide credible data. Researcher input and research supervisors determined the measure of variability and questionnaire degree to determine its claim to (validity). The researcher piloted the study to check the research questionnaire validity.

3.7 Data Analysis and Presentation

Data analysis ensures giving significance to data gathered to respond to research questions and realize the study goals (Gliner, Morgan, & Leech, 2000). Statistical Package for Social Sciences-SPSS and Ms. Excel were both used to analyze collected data in computations. The two data sets included key informants and respondents. For key informants (county government ministry of water 5, Kiambere-Mwingi water and sewerage company 3 (technical manager, billing and metering), water vendors (10), focus groups (3), Mwingi municipality (environment officer). For questionnaires, the respondents were (households, residential, industries, hotels and guest resorts). The key informants helped in analyzing the capacity for water provision and formed the basis for sustainable water provision and supply. The respondents are the consumers hence they create demand which needs reliable and sustainable supply of water

3.8 Ethical Issues and Consideration

The department of architecture in university of Nairobi issued the researcher with recognition letter and supervisor prior to data collection. The researcher sought permission from the participants by enlightening them that findings of this study are purely for academic purposes. Assurance of respondents' confidentiality and anonymity for the information provided.

3.9 Matrix of variables, data needs, sources and analysis technique

Objectives	Variable	Data needs	Data Sources	Analysis Technique
Challenges of water supply	Dependent	Access challenges Water Quality Affordability Population Suitability	Primary	Bar graphs Percentages
Governance issues and concerns	Independent	Water infrastructure Policy framework Water institution Water rationing Water policy Water governance Water actors	Primary Secondary	Bar graphs Percentages
Water supply opportunities	Moderating	Demand Supply Consumption Private involvement Water vendors Water resources	Primary Secondary	Bar graphs Percentages
Sustainable water solutions		Water harvesting Boreholes Dam construction Water pricing Water policy	Primary Secondary	Bar graphs Percentages

Table 1; Matrix of data needs, sources, and analysis technique

Source: Author 2023

CHAPTER FOUR

4.0 SITUATION ANALYSIS

4.1 Introduction

This study section describes Mwingi town at a glance while identifying specific aspects of the study area. It helps in developing a basis of understanding of the environment in which the study is being undertaken by providing a common reference point for the study process and prioritize actions. This chapter is divided into sections namely; brief history, geographical location, population dynamics, natural elements, economic characteristics, socio-economic features and consumer analysis.

4.2 Brief history

Mwingi town started back in early 1940s as a trading center and stopover for the eastern vehicles. This is due to its strategic location along the Nairobi – Garissa highway. It serves as the main center for the larger Mwingi region. It was the headquarters to former Mwingi district. The town development was contributed by the trading activities between Kambas and Arabs. Until 1990, Mwingi was recognized as a town council and in 1993 had its first mayor (chairperson to the town council). With the review of constitution in 2010, Mwingi was conferred to Town Administration and had its first town administrator in 2013. The operations and activities in the town were operationalized through town administration. In May 2021, Mwingi was conferred as municipality with municipal manager from January 2022. Mwingi town is the second largest urban center in Kitui County. Kitui County has two municipalities namely Kitui municipality and Mwingi municipality. All through Mwingi town has experienced serious water crisis. Mwingi is in arid and semi-arid areas, which are characterized by water scarcity. There is no research conducted specific for water shortage and scarcity in Mwingi town.

4.3 Geographical location

Mwingi town is located in Kitui County, eastern region, of the republic of Kenya; with an urban population of 80803 people (2022 urban areas census). The town is located along Nairobi-Thika-Garissa A3 Road, 47 Kilometers north of county headquarters, 171 kilometers east of Nairobi and it served as capital of the previous Mwingi district. The location coordinates are eastings 395398, and northings 9896834, with an altitude (elevation) of 1037m. Mwingi town bounds the sub-counties of Mwingi west and Mwingi central. Below is the location map of Mwingi town.

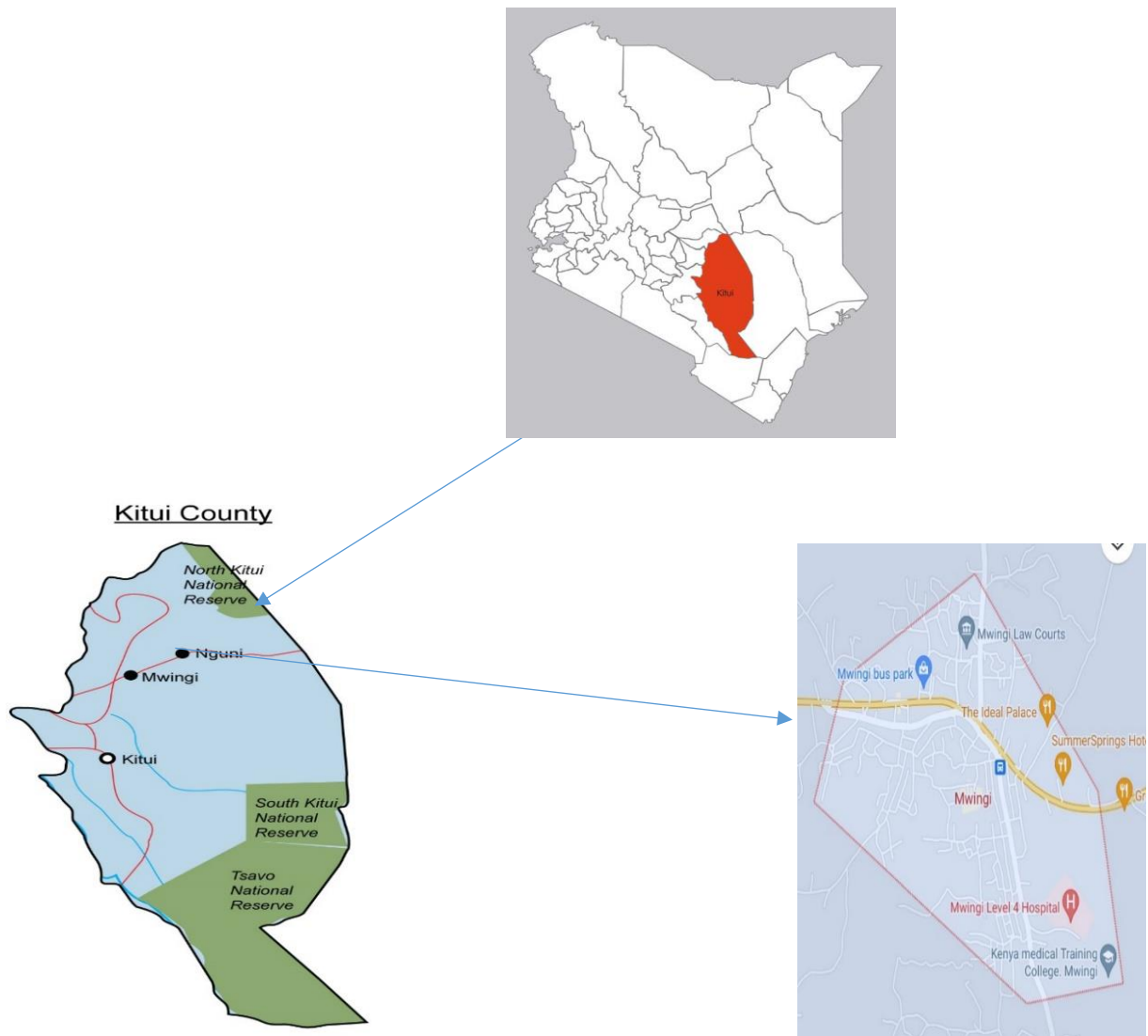


Figure 3 Mwingi Town Location map;
Source, Google 2022.

4.4 Population dynamics

Population growth is progressive in Mwingi town with record from 1975, approximated at 6000 residents, in 1990 with 14,000 residents, in 2000 with 16,000 people and in 2015 with 20,000 people both male and female. There is a population increase of 257.5% from year 1975 to 2015, with 27% from year 2000 to 2015. As of 2022, the population in Mwingi municipality is 80,813. The population density is 12,407/km². The population is projected to be 100,360 people in 2030 and 150,000 people in 2050.

Administratively Mwingi Town area lies in Mwingi central village (Mwingi central ward) and Kyanika village (Kivou ward) with population of 15,544 and 5,250 people respectively, giving a township population of 20,794 people in the township area. This population increment in the town with minimal water management intervention creates scarcity of the utility.

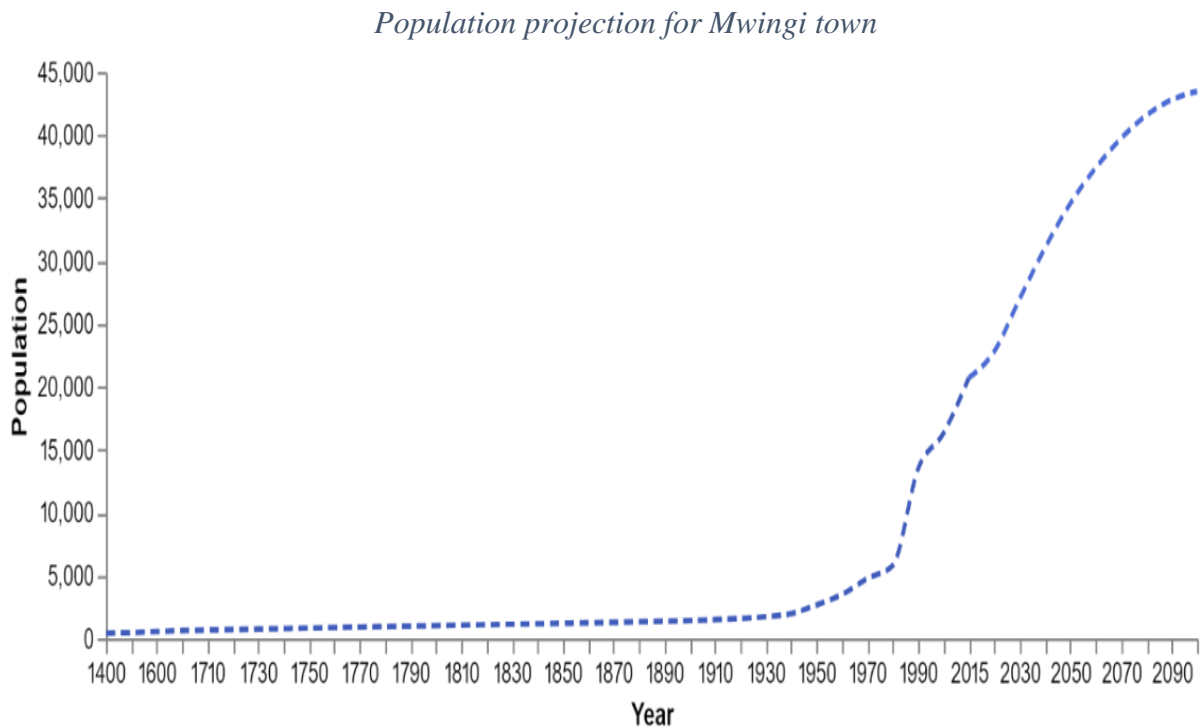


Figure 4 Population projection for Mwingi town

Source, KNBS 2019.

Population pyramid for Mwingi town (with age and gender composition)

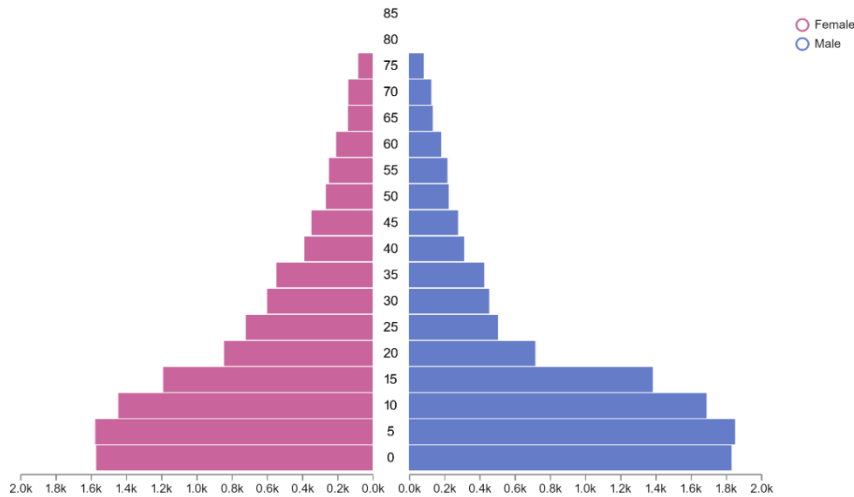


Figure 5 Population pyramid for Mwingi town (with age and gender composition)

Source, KNBS 2019

4.5 Natural elements

Mountains and rivers, with hills and streams running across the town, characterize topography in Mwingi. Mwingi town is home to Kautha rock (the tower for KiMWASCO tank), Kyanika rock and Ivia iu rock. It has a section of River Tyaa crossing in southeast to west with approximate of 3 kilometers and Kivou River to east with approximate 2 kilometers. Weather in the town is 24⁰C, Wind NE at 13 km/h, 69% humidity. The rocks can be utilized as water towers for storage tanks.

4.6 Economic characteristics

Mwingi town is the second largest town in Kitui County, now conferred to be municipality. It is the center and leading economic hub for the larger Mwingi region. The economic activities in Mwingi are trading, bodaboda, hardware, hotels and restaurants, guesthouses, supermarkets, hawking activities, residential housing, and light industrial activities. The town has two modern open markets, one main bus stage. The town serves as main economic hub for neighboring areas and the market day is on Wednesday. The town is partially improved with tarmacked roads to enhance mobility and spatial interactions. Ninety five percent of the town is connected to

electricity and has improved access to all facilities. The township has the financial institutions like banks (Equity bank, KCB, Cooperative bank, Faulu bank and Postbank) and micro-finances.

4.7 Socio-Cultural features

These are the social, religious, educational and cultural features and activities in the town. A large majority of the residents belong to the Kamba (Kikamba language as mother tongue) a Bantu people. Several other Kenyan communities like the Luo, Somali, Arabs and Kikuyu also inhabit the town. The town houses majorly two religions; Christians and Muslims. It has churches like Catholic Church, AIC church, Full gospel, Baptist among others as well as two mosques. Major schools in Mwingi town include Mwingi Boys', St. Joseph's Junior Seminary, Kathonzweni Secondary School, Kyanika secondary school, Mwingi central primary, Kasina Primary school, Kivou Primary, Kasevi secondary, Kasevi primary school, Mboru Primary school, Tyaa Secondary and Tyaa primary school. Among private education facilities are Mwingi east-view academies, St. Gabriel academy, Victors academy, Muthainga academy among others. The town has two main recreational grounds namely Mwingi sport ground (Musila gardens) and Kiima kiu gardens. The town has a well-designated waste disposal site for liquid and solid waste produced in the town. The township has a Mwingi level IV hospital public facility and other private medical facilities including Mwingi Medicare, Mwingi Specialist, Family Nursing, Tahidi Nursing, Mumbuni Nursing among others. The socio-cultural features determine the socio-cultural factors in water demand and supply. They define the daily running and activities operationalization in the town, and they require good supply of water hence their usage should be effectively monitored. The socio-cultural factors determine water needs because they form a bigger percentage of community and society.

4.8 Consumer analysis/ market situation.

The rising demand for water and its scarcity have turned into a noticeable livelihood universal encounter. Global warming, water contamination, population growth, urbanization and improper management of water resources deepened water shortage concerns. Water scarcity likely affect socio-economic activities, foods security, education and health, clean water and sanitation, sets several targets of making water sustainable for use by the year 2030 (UNEP, 2008). Kenya with rapidly growing population is described as water-scarce country because of its low supply of renewable freshwater ($\leq 1000\text{m}^3/\text{capita}/\text{year}$) UNEP, 2008.

The current demand of water in Mwingi stands at $11,000\text{M}^3$ a day (KiMWASCO 2021) which comprises of households, government offices, schools, residential premises, commercial premises and enterprises. The current supply of water in Mwingi stands at $2,700\text{M}^3$ a day, by KiMWASCO a semi-autonomous government agency responsible for water supply and provision in Mwingi township area. The water supply and connection is piped and metered with a stand-by rate of Ksh. 580 per month.

The consumer explore other mechanisms to get water, which includes water vendors, private supplies, stored rainwater, rivers and springs. The piped and metered connection by KiMWASCO to their consumers is 35% of the total households in demand for water (Technical Manager KiMWASCO, 2022).

4.8.1 The water consumers in Mwingi Township face problems of;

- a) Water rationing (it is available on Tuesdays and Saturdays). This causes inadequate water for town operations requiring huge amounts of water, like hotels, industries and hospitals.

- b) Inadequate supply (not consistent enough to meet the needs); the amount of water supplied by KiMWASCO and private water vendors is in small quantities and this limits supply to consumers.
- c) Access challenges (the consumers without KiMWASCO connection); this situation worsens as the consumers depend on water vendors and other private water supplies making it expensive to get water. The long distance to water kiosks and unreliable transportations makes the water cost high. In case of a rationing the consumers use untreated water from the streams and nearby rivers which sometimes may be polluted.
- d) Poverty level (limits the households from private piped connection); the water vendors sell a 20 litre jerician at Ksh. 20 – 30 on Tuesdays and Saturday, then Ksh. 40 – 50 on days without water. This escalates during water crisis like drought and dry-spell periods.
- e) Rainwater harvesting; most of households have not established mechanisms to harvest rainwater. This constrains the capacity of water supply for consumption in the town because there is overdependence on KiMWASCO water supply.

4.8.2 The challenges faced by water providers include, but not limited to;

- a) Rapidly increasing population stretches the capacity of water supply. The capacity of KiMWASCO to supply water is way below the demand. This is because the growing demand for water does not have effective supply response.
- b) Inadequate infrastructure for water supply (piping and the water reticulation systems); the water infrastructure in place does not cover the township area at whole. This limits the chance of water consumptions to the targeted populations.

- c) Vandalism and mismanagement of existing infrastructure (exposes damages); the existing infrastructure is aging and has minimal replacements. The vandalism for the pipes create a challenge of water supply to the targeted consumers.
- d) Unaccounted for water; the water lost because of infrastructure leakages and vandalism. There are illegal water connections that are not metered hence the loss in water revenue.
- e) Inadequate financing (because of inadequate billing from the water supplied and from (national and county government allocation). This limit the capacity to expand the water infrastructure from the sources.
- f) Mismanagement of water resources and catchment areas within and without the township water supplies. This minimizes the chances of increment in water supply and constrains KiMWASCO capacity to supply water.
- g) Non-utilization of storm water; all the water drains to the nearby streams and rivers (Tyaa river and Kivou river). There is no mechanism in place to reserve these huge amounts of water. This water can be used for greening and gardening the town as well as in urban agriculture to create an alternative source from the nearby rural suppliers. The water can also be treated and used for domestic and construction uses.

4.8.3 The generic challenges in the area are;

- a) Inadequate and minimal amounts of rainfall; the area receives rains twice a year (April and November) with a mean annual rainfall of 300mm. This requires adequate governance capacity to utilize the rainwater for use to its people.
- b) Pollution; for water and environment. Through liquid and solid waste produced because of township activities (hotels, residential units) and continued human settlement. This is due to increased housing demand because of rapid population growth.

- c) Climate change and global warming; this is a universal challenge and mostly for developing countries because they contribute less in environmental pollution but they suffer most as a result of it compared to developed countries.

4.8.4 Mitigation measures to this underlying water scarcity include;

- a) Making water policies geared towards ensuring the protection of water catchment areas
- b) Continuous engagement in activities aimed at reducing pollution
- c) Improving and enhancing access to hygienic water for all uses.
- d) Extension of KiMWASCO operations to other parts of the municipality.

CHAPTER FIVE

5.0 DATA ANALYSIS, FINDINGS AND DISCUSSIONS

5.1 Introduction

This study aim was to examine the contributions of governance to water availability in Mwingi town. This chapter comprises research-finding presentation garnered from the field investigation, findings discussion, analysis conducted to support the study objectives, and discussion of the challenges encountered during the field survey in outline.

5.2 Respondents and Household Characteristics

5.2.1 Sex and Age of the Respondent

Majority of household respondents were female at 54% while males were 46%. The study did attempt in attaining a proportionate balance on the sex of the participants. It was also within the Kenyan constitutional requirements of inclusivity and ensuring gender rule is upheld (third of either gender is represented) in any undertaking. Majority of household study participants aged 35 years and below. Notably, the participants were all above 18 years, of legal age and able to make decisions, give ideas and opinions as regards the study. The largest proportion of participants were aged between 26 and 35 years at 39% while those above 46 years at 8 percent represented the least age.

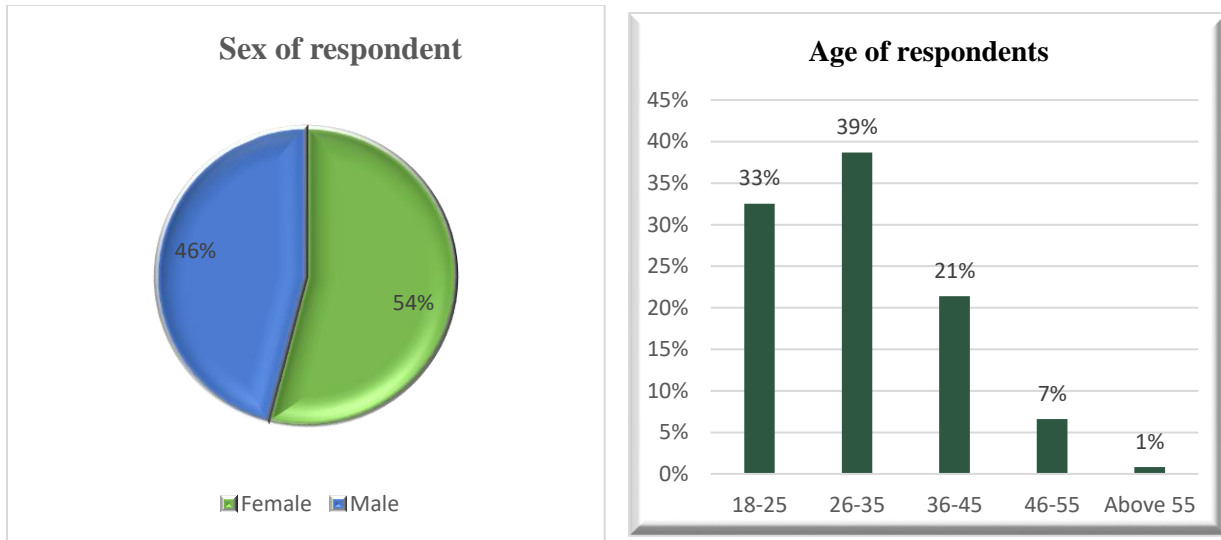


Figure 6 Sex and Age of Respondents

5.2.2 Education Level and Marital Status of Respondents

Household respondents were at least primary school graduates. Significantly, most respondents had attained secondary education and above, translating to 82% of all study participants. Essentially, only 17% of respondents had dropped at primary level and below, the rest of the participants had attained post-primary education.

The highest proportion of respondents were married at 54% while 43% others were single, unmarried at all. A small proportion of participants were either widowed, separated or divorced at 1 percent apiece.

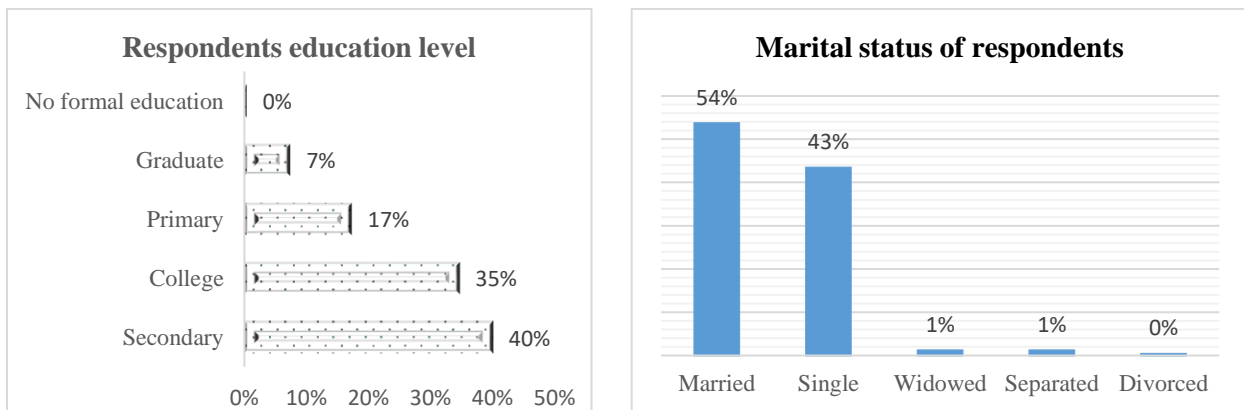


Figure 7 Respondent's Level of Education and Marital Status

5.2.3 Occupation of Household Head

Most of household heads were self-employed at 34% while 26% others were business people. Formal employment was made up of 13% of the respondents while a significant 19% were students. Notably, participants occupied in more than one economic activity with business people being self-employed while employed participants and students also engaged in business activities. These actions increased chances of income generation to the household while limiting unemployment rates within the study area.

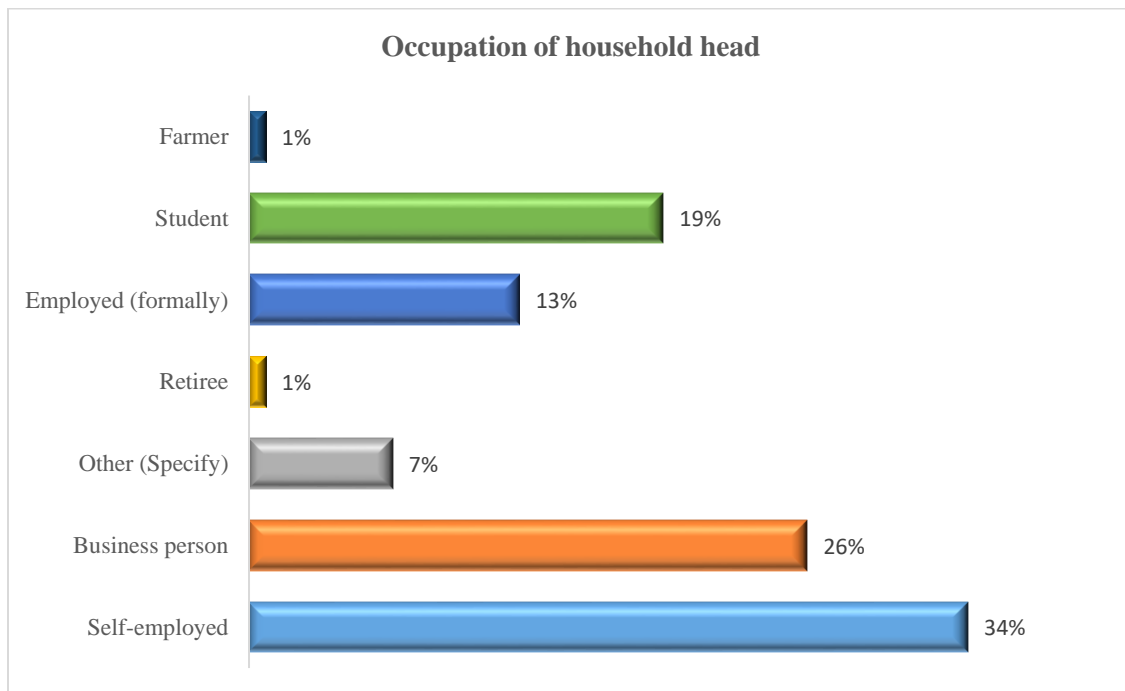


Figure 8 Occupation of household head

5.2.4 Household Size

The majority of households represented in the study had an average size of between 1 and 4 members at 62% while 36% others averaged between 5 and 8 members. Only a small percentage of 2 had household size that exceeded eight members.

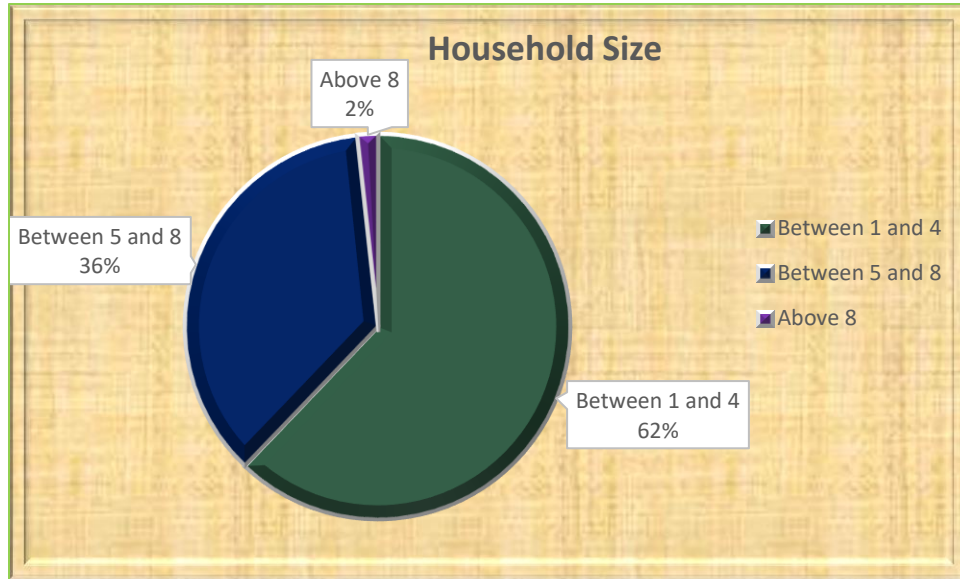


Figure 9 Household size

5.3 Household Water Characteristics

5.3.1 Main Source of Water for Households

Majority of the households obtained water from water kiosks at 37%. Further, another 35% obtained their household water from KIMWASCO which is a water and sewerage company serving the study area. Importantly, residents' water supply was by KIMWASCO except for private borehole water and water obtained from streams and rivers. Other sources of household water constituted of water vendors, private borehole, and river/stream at 11, 10 and 5 percent correspondingly.

<i>Main Source of Household Water</i>	<i>Frequency</i>	<i>Percentage</i>
<i>Private borehole</i>	30	10%
<i>Water kiosk</i>	108	37%
<i>KIMAWASCO</i>	101	35%
<i>Water vendors</i>	33	11%
<i>River/stream</i>	15	5%
<i>Public borehole</i>	2	1%
<i>Communal yard tap in plot</i>	2	1%
<i>Rainwater harvesting</i>	1	0%
<i>Total</i>	292	100%

Table 2 Main Source of Household Water

5.3.2 Distance Traveled for Water Access from source

Residents reported that they had to walk to access water. The majority of them walked less than 20 meters to access water at 27%. Another significant proportion of 21% apiece reported walking for either between 201 and 500 or between 501 and 1000 meters to access the precious commodity. The majority of households interviewed, 42%, covered a significant distance to access water, being between 201 and 1000 meters. Further, 16% of participants covered between 101 and 200 meters to access water while 10% others had to do with between 21 and 100 meters to access the key domestic commodity. A smaller proportion of participants, approximately 5% had to do with over a kilometer to access water for household consumption.

<i>Distance between house and main water source</i>	<i>Frequency</i>	<i>Percentage</i>
<i>Less than 20M</i>	65	27%
<i>Between 21 and 100M</i>	23	10%
<i>Between 201 and 500M</i>	51	21%
<i>Between 101 and 200M</i>	39	16%
<i>Between 500M and 1KM</i>	51	21%
<i>Above 1KM</i>	12	5%
<i>Total</i>	241	100%

Table 3 Distance between house and main water source

5.3.3 Water Connection at Household Compound

Most of households represented in the survey did not have water connection at household level, being 59% of the respondents. Conversely, 41% of study participants had water connected at their households and thus obtained water from taps installed within their residential compounds.

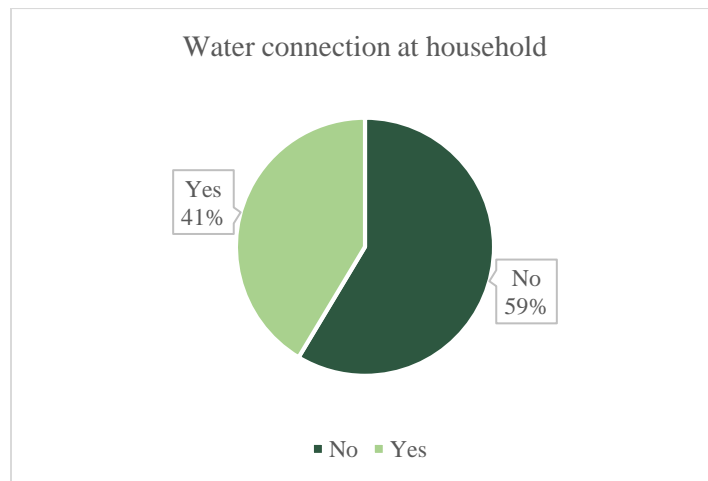


Figure 10 Water connection at household

5.3.4 Daily Average Household Water Consumption

The daily average water consumption in a household ranged between 21 and 60 liters for 49% of respondents, between 61 and 100 liters for 43% of participants while another 3% percent consumed on average in excess of 100 liters a day. There was a small portion of participants, approximately 5% whose average water consumption in a day was less than 5 liters.

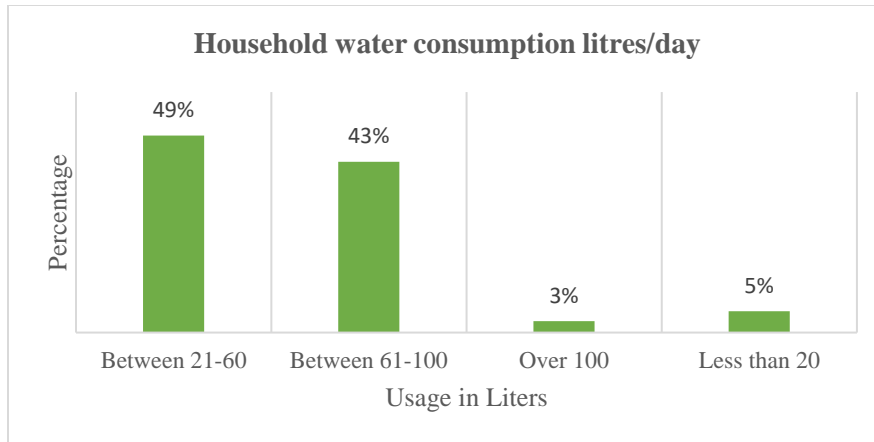


Figure 11 Household water consumption litres/day

5.3.5 Frequency of Water Shortage incidents

The significant proportion of respondents experienced water shortage on a weekly basis, reported at 89%. This is a clear indication of water access challenges within the study area. The smallest share of respondents had experienced water shortage either daily, once every three months or monthly at 1, 2 and 5 percent correspondingly.

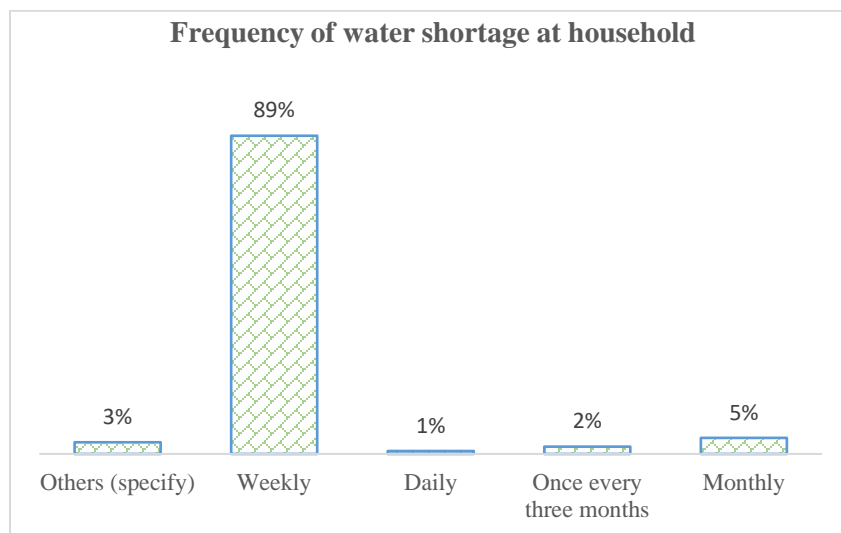


Figure 12 Frequency of water shortage at household

Notably, all respondents who specified other water shortage parameters at 3% all observed that they never experienced water shortage at all. This makes an interesting perspective since the study was conducted within the same geographical sphere.

5.3.6 Alternative Sources of Water at Household level

Following reportedly high-water scarcity levels, earlier reported at 89%, residents had to establish alternative channels of accessing water. Notably, 72 percent of residents had devised alternative water sources to help deal with the water shortage situation. This contrasted the 28% who did not have alternative means of accessing water. Potentially, they lied in the category of those households with least water shortage issues or they did nothing about their situation, opting to wait for the dry days to lapse while they relied on their stocks. This ideally implies they stored high quantities of water to take the households through the dry tap days within the week or month.

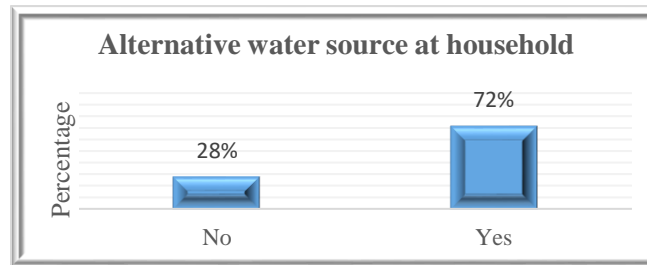


Figure 13 Alternative water source at household

The 72% who had alternative water sources obtained water mainly from water vendors, water kiosks, and River Tyaa at 55, 19 and 13 percent respectively.

<i>Alternative Household Water Sources</i>	<i>Frequency</i>	<i>Percentage</i>
<i>Green power</i>	<i>1</i>	<i>1%</i>
<i>Private Borehole</i>	<i>9</i>	<i>5%</i>
<i>Water Kiosk</i>	<i>37</i>	<i>19%</i>
<i>Water vendors</i>	<i>104</i>	<i>55%</i>
<i>Kimawasco</i>	<i>1</i>	<i>1%</i>
<i>Private Borehole - salty</i>	<i>1</i>	<i>1%</i>
<i>River Tyaa</i>	<i>24</i>	<i>13%</i>
<i>Private water supply</i>	<i>5</i>	<i>3%</i>
<i>Shallow wells</i>	<i>2</i>	<i>1%</i>
<i>Public borehole</i>	<i>3</i>	<i>2%</i>
<i>Rain water harvesting</i>	<i>1</i>	<i>1%</i>
<i>Tapped plots</i>	<i>2</i>	<i>1%</i>
Total	190	100%

Table 4 Alternative Household Water Sources

5.3.7 Rainwater Harvesting

Majority of household respondents observed that they harvested rainwater at 80% with only 20% respondents not harvesting rainwater. Those who harvested rainwater used drums, water jerry cans, buckets and plastic water tanks as their main water preservation means. Most of the respondents used multiple storage facilities for harvested rainwater as shown in the table below.

<i>Storage of harvested rain water</i>	<i>Frequency</i>	<i>Percentage</i>
Drums, Buckets/water jerrycans	128	66%
<i>Drums</i>	9	5%
<i>Buckets/water jerrycans, Galvanized iron sheet tanks</i>	1	1%
<i>Drums, Plastic water tanks</i>	3	2%
<i>Plastic water tanks</i>	16	8%
<i>Masonry/Concrete tanks</i>	1	1%
<i>Buckets/water jerrycans</i>	15	8%
<i>Drums, Buckets/water jerrycans, Masonry/Concrete tanks, Plastic water tanks</i>	1	1%
<i>Drums, Buckets/water jerrycans, Masonry/Concrete tanks</i>	1	1%
<i>Drums, Plastic water tanks, Buckets/water jerrycans</i>	1	1%
<i>Buckets/water jerrycans, Drums, Plastic water tanks</i>	6	3%
<i>Drums, Buckets/water jerrycans, Plastic water tanks</i>	2	1%
<i>Buckets/water jerrycans, Plastic water tanks</i>	5	3%
<i>Plastic water tanks, Buckets/water jerrycans</i>	2	1%
<i>Buckets/water jerrycans, Drums, Masonry/Concrete tanks</i>	2	1%
<i>Buckets/water jerrycans, Plastic water tanks, Drums</i>	1	1%
Total	194	100%

Table 5 Storage of harvested rain water

The combination of drums, buckets/water jerry cans was the most common mode of preserving harvested rainwater at 66% of all storage facilities. Other notable rainwater harvesting storage equipment used by households comprised of plastic water tanks and a combination of buckets/water jerry cans at 8% apiece.

5.3.8 Quality of Water Supplied

Majority, i.e., 63%, of the study participants, reported the quality of water supplied at household level as good while only 4% observed that the water quality was very good. By contrast, 16% of

the participants noted that the water supplied to them was of poor quality while a significant 17% other were indeterminate on the water quality as either good or bad.

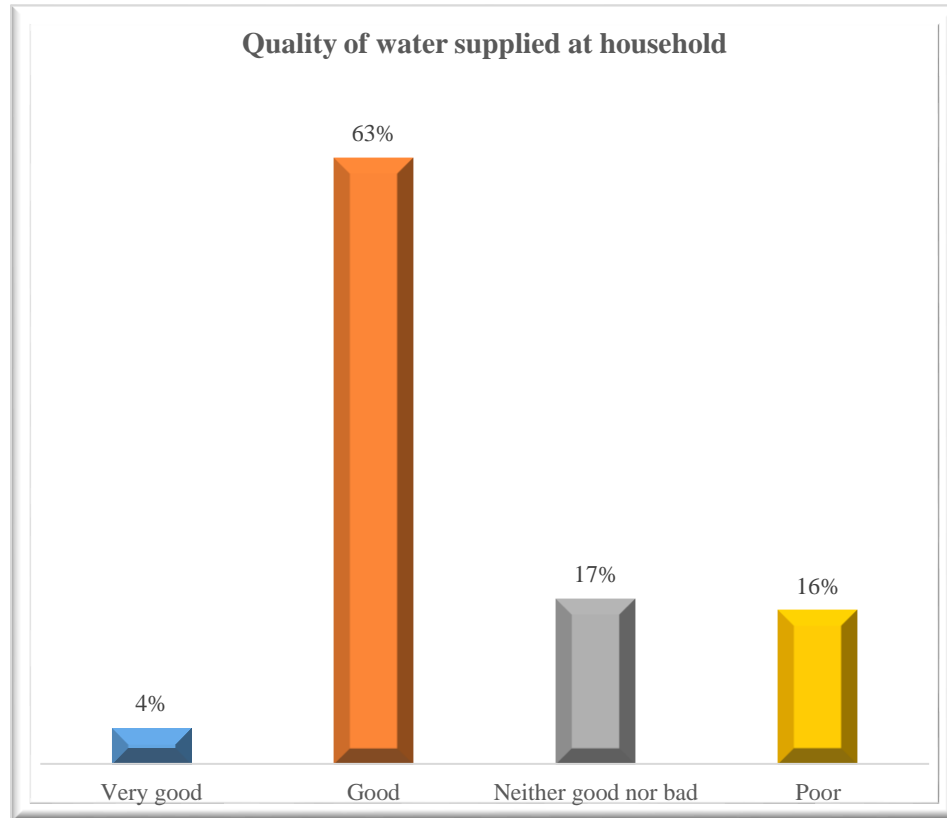


Figure 14 Quality of water supplied at household

5.3.9 Reduction of Water Wastage at Household level

Households adopted measures to contain water losses via wastage. The most adopted actions included limited washing of clothes (washing at the right time – only when it was necessary to do so) at 47%, turning off water taps while not in use at 23%, and not washing dishes under running tap water at 12%. Other measures to combat water wastage comprised of civic education to family members on the essence of water conservation, taking less time in the shower to reduce water wastage while bathing, and repair of leakages in water pipes, especially indoor water leakages.

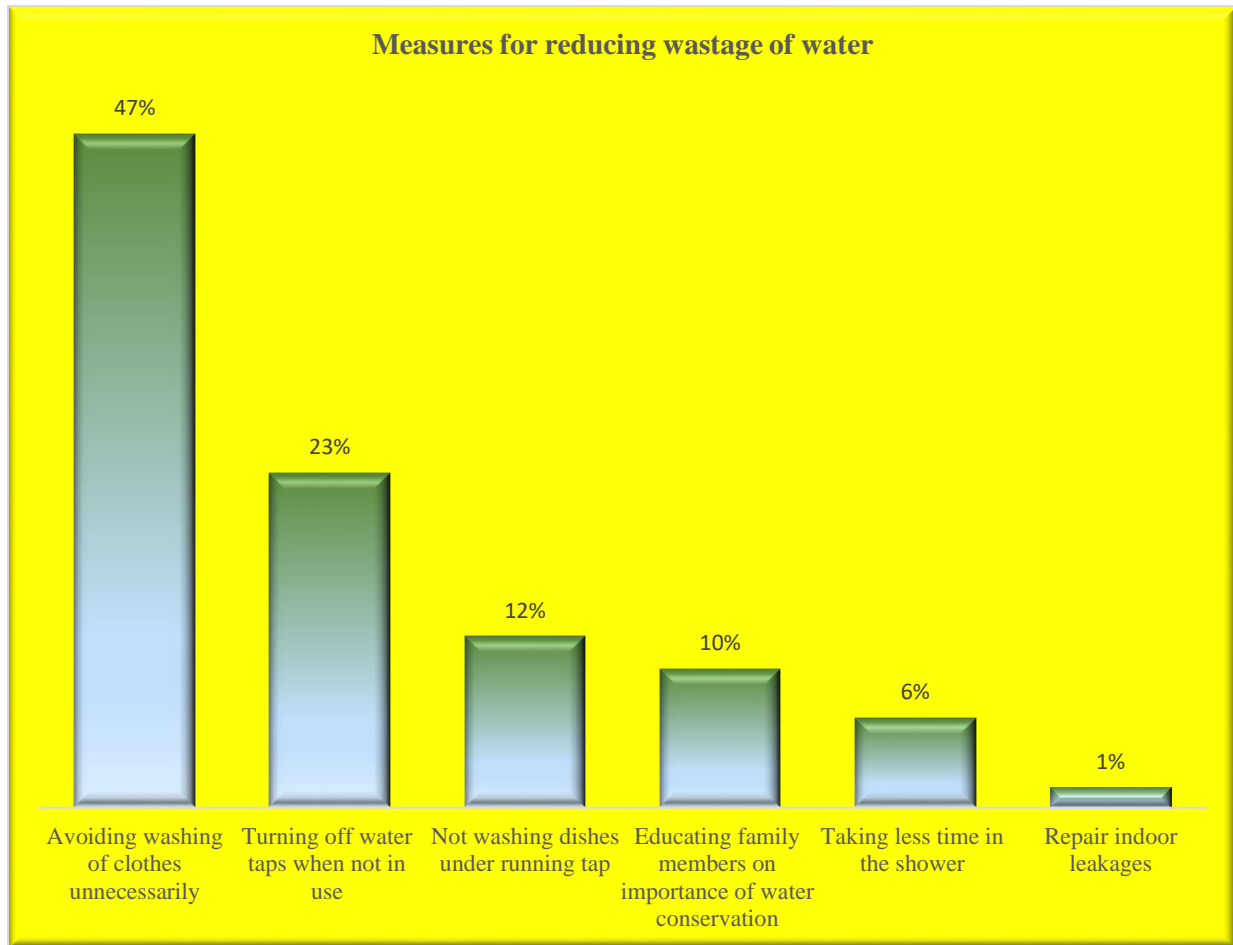


Figure 15 Measures for reducing wastage of water

5.3.10 Estimated Household Water Expenditures

The gathered data shows that majority of households within the study area spend in excess of Ksh. 2000 per month at 51%. Another significant portion of the study population estimated their monthly water expenditures to between Ksh 501 and Ksh 2000 at 44%. Only a small proportion of respondents who spend less than Ksh 500 per month on water, equivalent to 6% of all study participants. This high cost of water could possibly be attributed to the fact that water was accessed via purchase from water kiosks, or water vendors who would increase the margins for significant profits, and a potential pottering/transportation cost. There is potentially a close correlation between the cost of water and distance between household location and water access points.

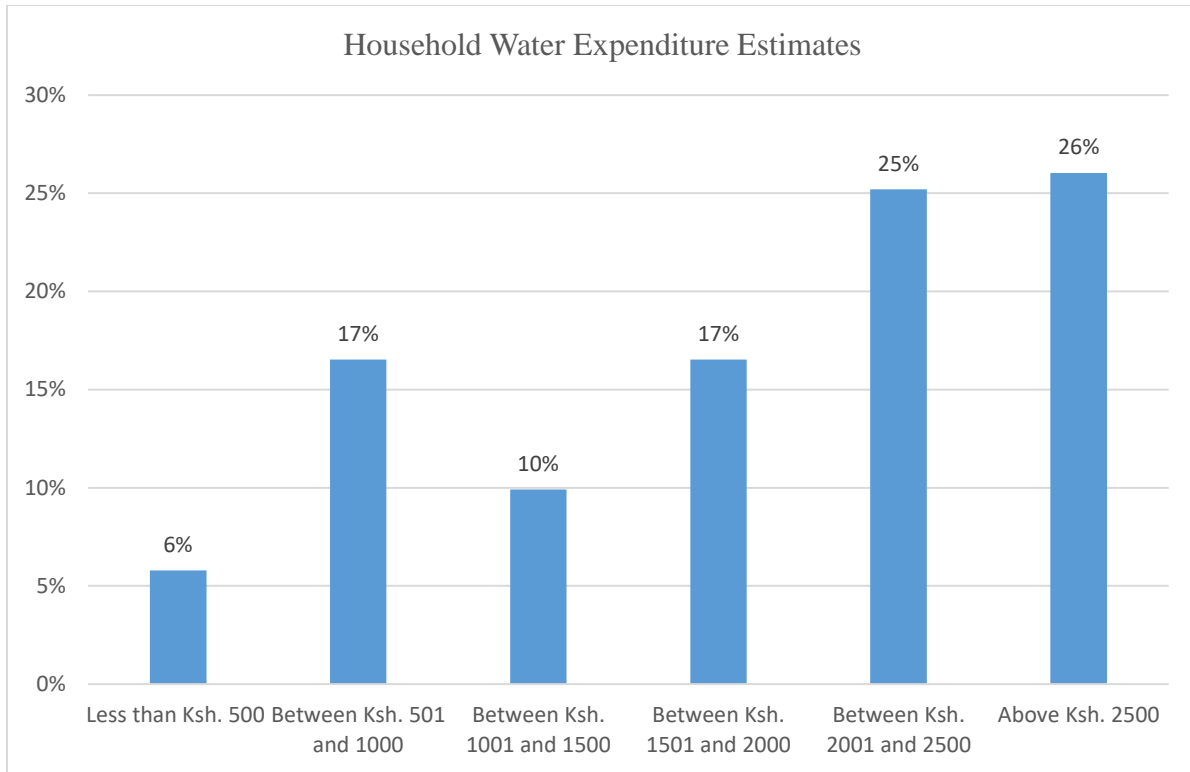


Figure 16 Household Water Expenditure Estimates

5.3.11 Rating Water Price per Unit

Asked to rate the cost of water per unit, a significant proportion of respondents observed that the water was expensive at 40% while another 30% felt that the cost of water per unit was very expensive. This translates to 70% of all respondents having opinion that the water was expensive with only 30% thinking otherwise. Of the 30%, 18% determined that the water was cheap while 11% were unable to determine whether the water was cheap or expensive, remaining indecisive on their evaluation of the cost of water per unit. This translated to implication there is existence of strong relationship between the water source and the attached cost. This would mean that those who obtained water from wells and rivers/streams did not feel the cost of water as too high as compared to those who purchased from water vendors and kiosks, and relatively inexpensive to those who had water connected to within their residential premises or nearby plots.

Rating water price per unit	Frequency	Percentage
Cheap	43	18%
Very cheap	3	1%
Neither cheap nor expensive	28	11%
Expensive	97	40%
Very expensive	73	30%
Total	244	100%

Table 6 Rating water price per unit

5.3.12 Rating Water Supply Services

The water supply services were lowly rated with 47% of respondents terming them as either poor or very poor. This compares either 43% of those who determined the water supply services as very good (4%) or good at 39%. A significant number of participants were held indeterminate between the supply services being good or bad.

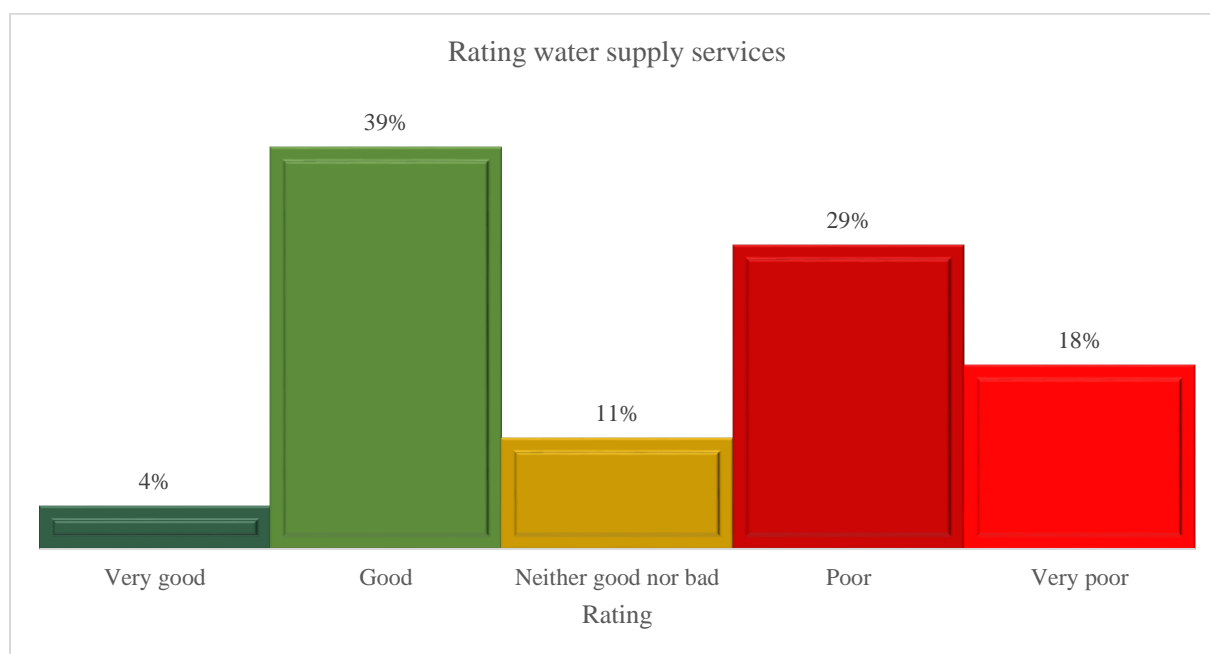


Figure 17 Rating water supply services

5.4 Characteristics of Business Respondents

5.4.1 Respondents' Nature of Business

Study participants under the business category were engaged in a variety of business. Mainly they engaged in commercial activities at 46%, and the hospitality industry at 37%. Others were in either the industrial, health or beauty services at 8, 7 and 3 percent accordingly.

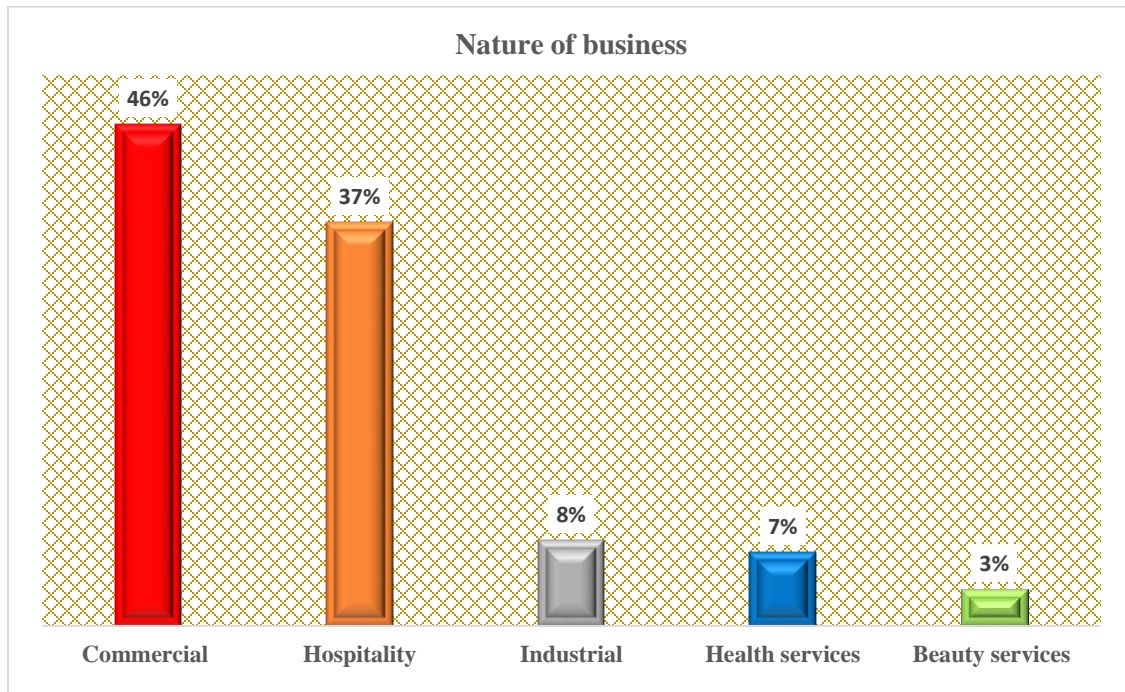


Figure 18 Nature of business

For those in commercial activities, they specifically engaged in wholesale and retail shops and supermarkets, hardware, wines and spirits businesses, LPG gas business, tailoring, barbershop among others. Hospitality activities participants engaged in comprised of hotel business, bar and restaurants, guesthouse, accommodation and lodging services, fruit vending among other hospitality-oriented activities. Industrial activities included garage, bakery and chemical products businesses. Health services comprised mainly participants operating chemists, health clinics/centres, hospital and provision of laboratory services. For those in beauty services, they comprised mainly cosmetics shops, salons, manicure and pedicure art services among others.

5.4.2 Position of Respondent in Organization

The respondents were employees, owners, managers, contractors or partners equivalent to 52, 30, 16, 1 and 1 percent respectively. The employees were either waiter/waitresses, attendants, barbers, beauticians among others. Managers, though employees of organizations, hold a significant rank and as such were singled out due to their authority within an organization and ability to make decisions and give detailed information for subject under investigation.

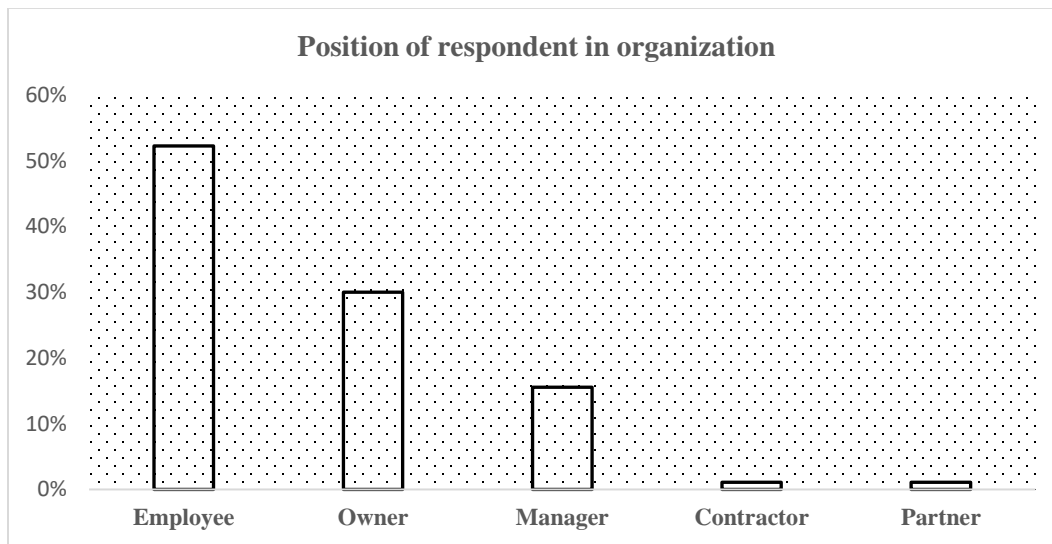


Figure 19 Position of respondent in organization

5.4.3 Main Sources of Water for Businesses

Most business organizations within the study area obtained water from water vendors at 71%, municipal water at 16% and water kiosks at 11%. Streams and private boreholes were other sources of water used by business entities at 1% each. The water vendors dominance as a main source of water for business entities indicates high levels of water scarcity within the town to be deep rooted. Vendors are relied upon to solicit for water from whatever distances for a fee. It can also be interpreted to indicate that business personnel are busy with limited time to go in search of water and opt to hire services of water vendors to support in water access while they concentrate on core business activities.

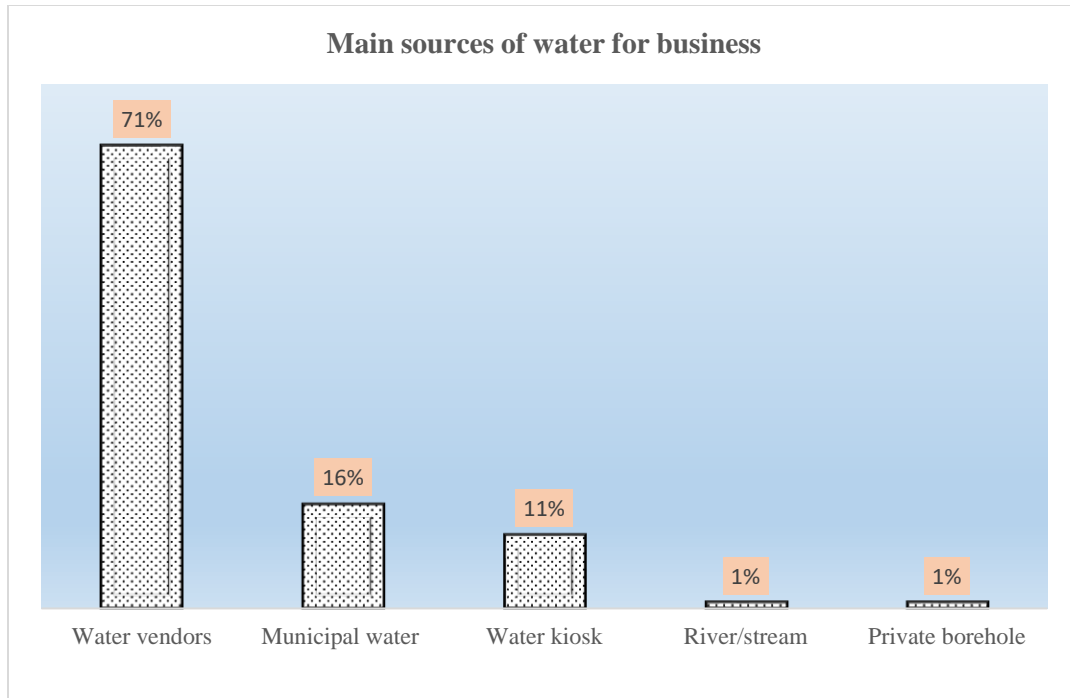


Figure 20 Main sources of water for business

5.4.4 Rate of Water Consumption by Businesses

Water consumption litres per day	Frequency	Percentage
Less than 100	48	53%
Between 101 and 300	22	24%
Between 301 and 600	10	11%
Between 601 and 900	4	4%
Between 901 and 1200	4	4%
Above 2100	2	2%
Total	90	100%

Table 7 Water consumption litres per day

Most of the businesses had water consumption levels of below 100 litres in a day at 53%. Another significant proportion of study participants had their businesses consume between 101 and 600 litres at 35%. The least of businesses consumed between 601 – 900 and 901 – 1200 litres at 4% apiece. Very few businesses consumed in excess of 2100 litres at 2%.

5.4.5 Frequency of Water Shortage at Business entities

A significant share of businesses experienced water shortage on a weekly basis at 88%. Further, another 9% of business entities experienced water shortage on a monthly basis while the least of businesses had water access issued once every three months at 3%. This indicates that only 3% had assurance of water access with least water shortage issues.

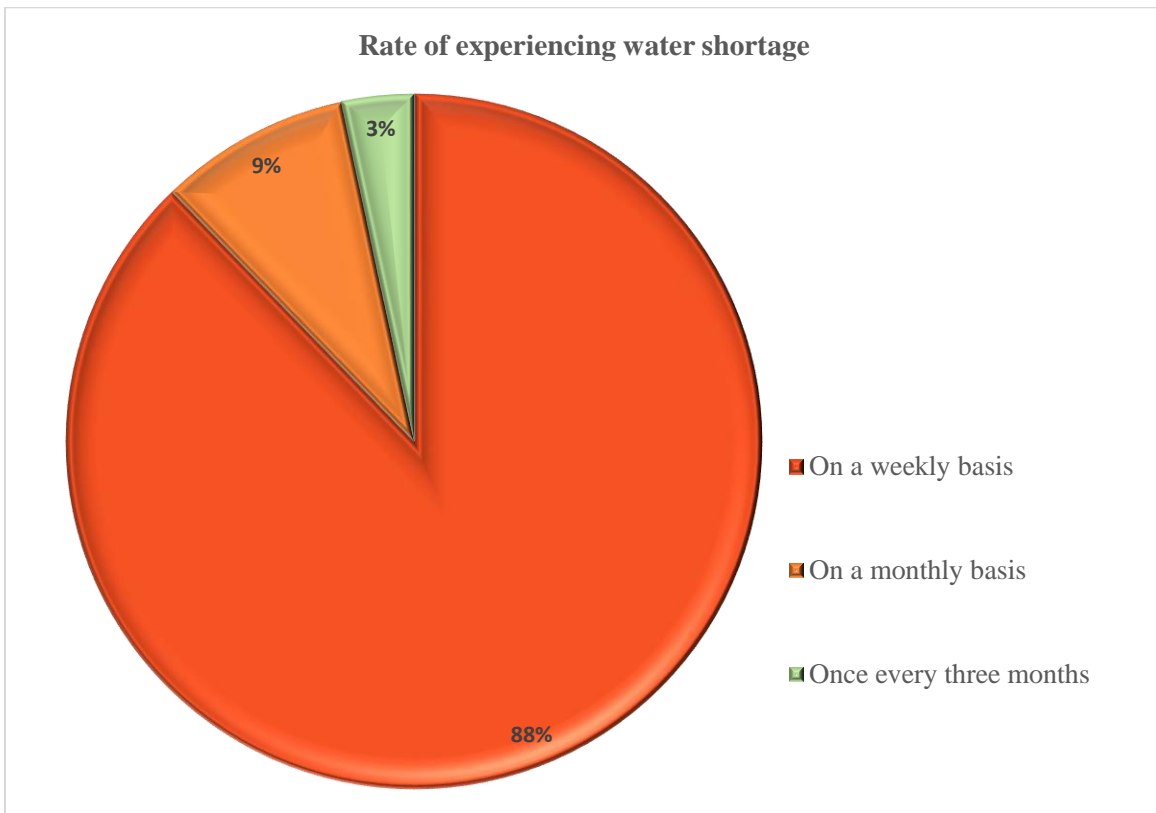


Figure 21 Rate of experiencing water shortage

5.4.6 Access to Alternative Water Sources

In cases of water shortage, just 20% of business entities indicated they had alternative sources of water supply. This contrasted to significant majority 80% who did not have alternative supply of water in times of shortage. This contrasts heavily with the rate of water shortage being high, 88% experienced water shortage on a weekly basis. Ideally, they are expected to have alternative sources of water to supplement water needs over water shortage spells.

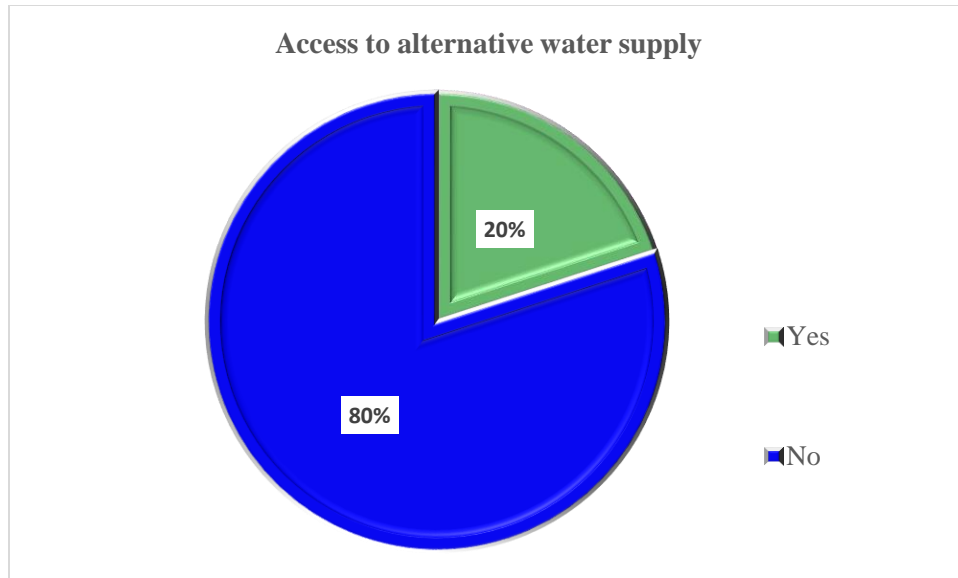


Figure 22 Access to alternative water supply

For the 20% who had alternative sources of water, majority of them, 61% acquired water from water vendors. This implies that water vendors were not their main source of water. The other 39% had their alternative water sources as rivers, private boreholes and water kiosks at 11% each while water tanks were the least alternative sources of water supply at 6 percent.

5.4.7 Harvesting and Storage of Rainwater

The business practitioners intimated that they did not harvest rainwater in numbers at 80% with only 20% of business entities harvesting rainwater. For them that harvested rainwater, they adopted multiple options for the storage of the harvested water. Significantly, business units used a combination of water storage drums and buckets/water jerry cans at 28%. Plastic water tanks, water storage drums, and masonry/concrete tanks were the most used single storage items (without a combination of other storage mechanisms) at 17% apiece.

For the majority 80% of businesses that never harvested rainwater, they attributed their reasons to the lack of rainwater harvesting mechanisms, nature of the building, and lack of storage facilities for the harvested rainwater as their main reasons at 36, 22, and 14 percent correspondingly.

Other reasons they never harvested rainwater included lack of time for harvesting rainwater, did not see the need to harvest rainwater, the type of roofing that did not qualify for water harvesting, and dirty roofs/iron sheets. Some never saw the need to harvest rainwater while others considered the exercise an impossibility.

Reasons for not Harvesting Rainwater	Frequency	Percentage
Absence of rainwater harvesting mechanism	27	36%
Nature of building	17	22%
No storage facilities	11	14%
No time for that	5	7%
No reason	4	5%
No need	4	5%
The type of roofing	3	4%
Dirty iron sheets	3	4%
Not possible	2	3%
Total	76	100%

Table 8 Reasons for not Harvesting Rainwater

5.4.8 Quality of Water Supplied

According to 71% of business respondents, the water supplied to them is of good quality while 13% observed that the water quality was poor. Further 13% of business study participants rated the water as neither good nor bad while 2% rated its quality as very poor.

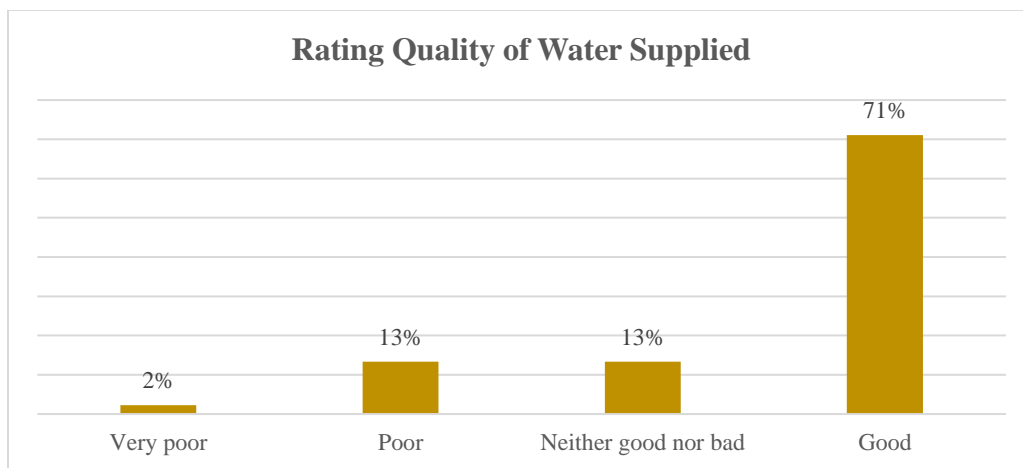


Figure 23 Rating Quality of Water Supplied

5.4.9 Challenges Experienced by Businesses in water access

Inadequate water in terms of water unavailability and low quantities of supplied water at 47% was the main challenge for businesses in accessing water. Other notable challenges included high cost of water supplied, and water accessed being salty at 22 and 6 percent respectively. Only 18% of respondents did not have water access challenges.

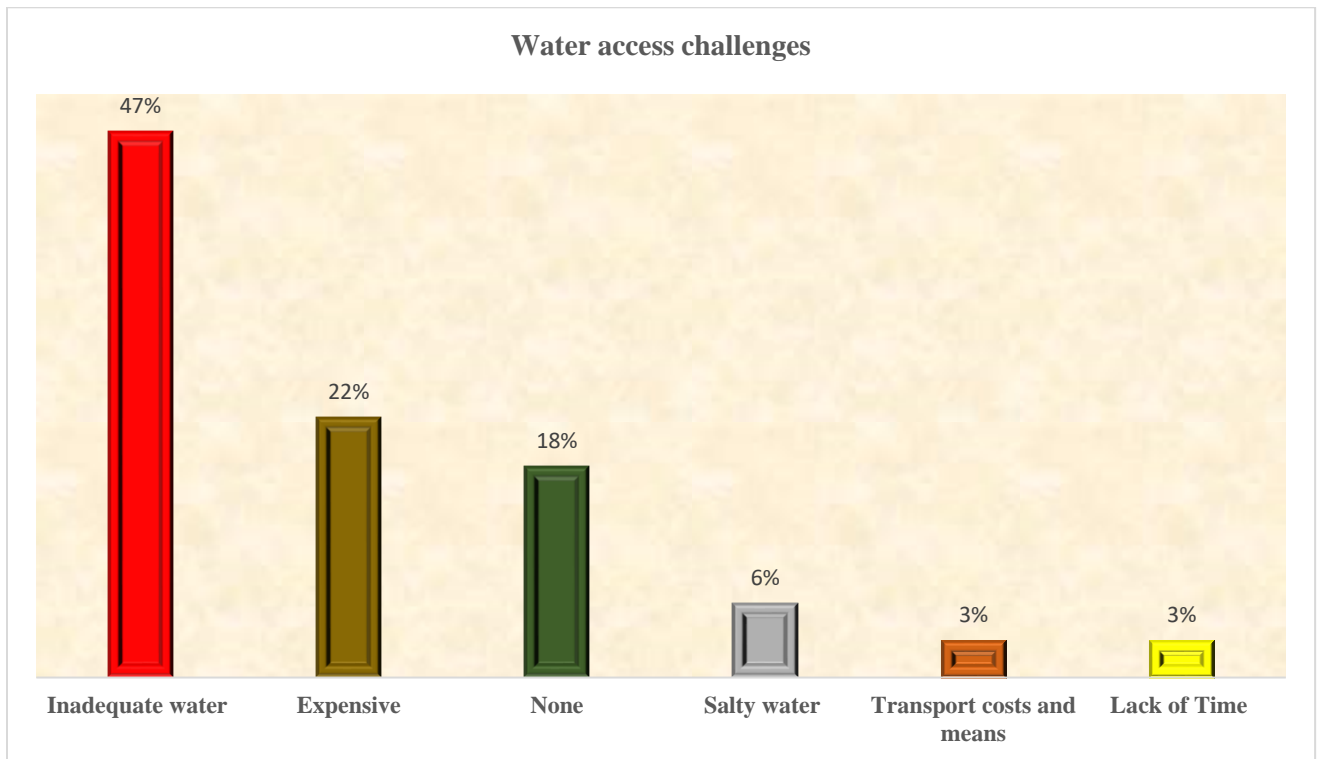


Figure 24 Water access challenges

5.4.10 Measures for Reducing Water Wastage

Business entities adopted mechanisms to minimize water losses via wastage, especially due to the scarcity of the commodity. Among the options at play included water recycling and educating their staff members on importance of water conservation at 49 and 42 percent accordingly. Other modalities employed comprised of turning off taps especially when not in use and installation of low flow showers for reduced water loss in bathrooms.

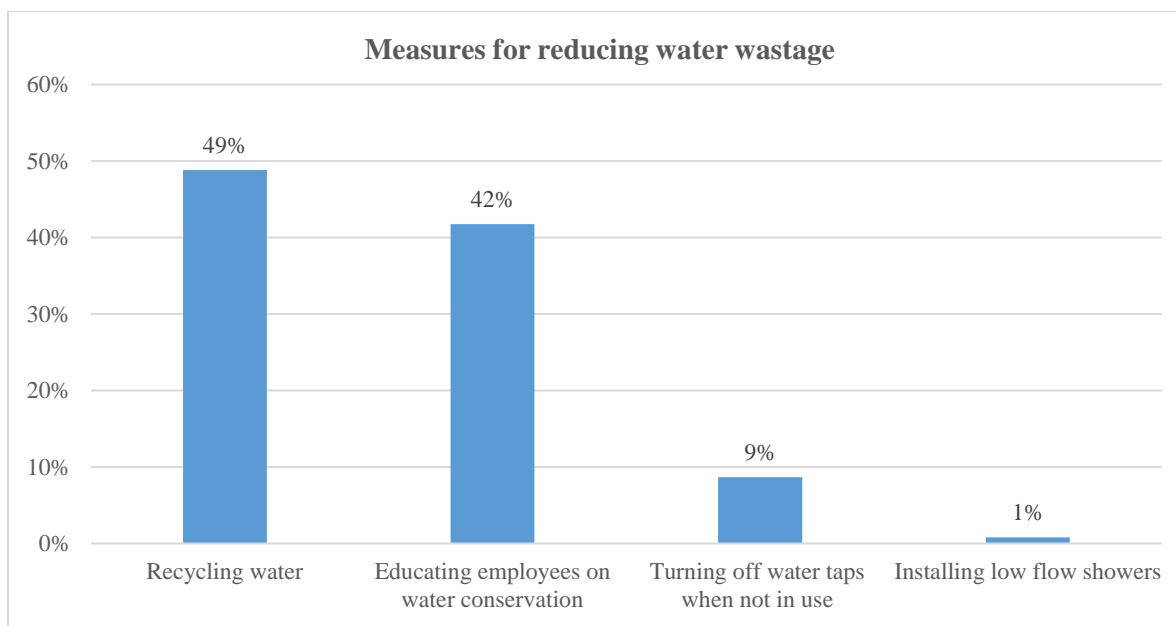


Figure 25 Measures for reducing water wastage

5.4.11 Monthly Business Expenditures on water

<i>Monthly Expenditures on Water</i>	<i>Frequency</i>	<i>Percentage</i>
<i>Below Ksh. 2000</i>	32	36%
<i>Between Ksh. 2001 and Ksh. 4000</i>	23	26%
<i>Between Ksh. 4001 and Ksh. 6000</i>	13	14%
<i>Between Ksh. 6001 and Ksh. 8000</i>	8	9%
<i>Between Ksh. 8001 and Ksh. 10,000</i>	3	3%
<i>Above Ksh. 10,000</i>	11	12%
Total	90	100%

Table 9 Monthly Expenditures on Water

A small proportion of business entities had expenditures on water well below Ksh. 2000 equating to 36%. Regrettably, water was very expensive for most of the businesses with expenditures beyond Ksh. 2000 being reported by 64% of respondents. Of these, 12% reported their monthly water bills exceeded Ksh. 10,000. Those who spend between Ksh 4000 and Ksh 10,000 were equivalent to 26% of all respondents in this category.

5.4.12 Rating of Price of Water per Unit

The study participants rated the water supplied per unit as expensive at 47% and very expensive at 14%. Only a small percentage of 19% rated the price of water supplied per unit as cheap or very cheap.

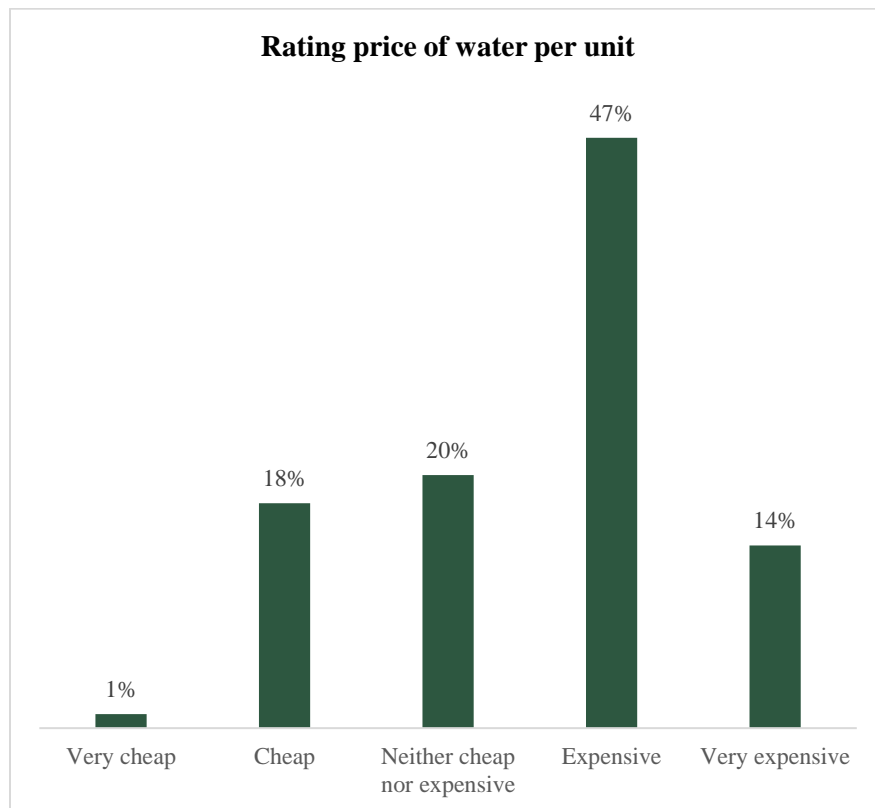


Figure 26 Rating price of water per unit

5.4.13 Rating Water Supply Services

The largest proportion of business respondents, 60% of them all, rated water supply services as either poor or very poor at 37 and 23 percent respectively. Notably, only a small proportion of 28% rated water supply services as good, neither of respondents rated them as very good. At a neutral position were some 12 percent of business people who rated the water supply services as neither good nor bad.

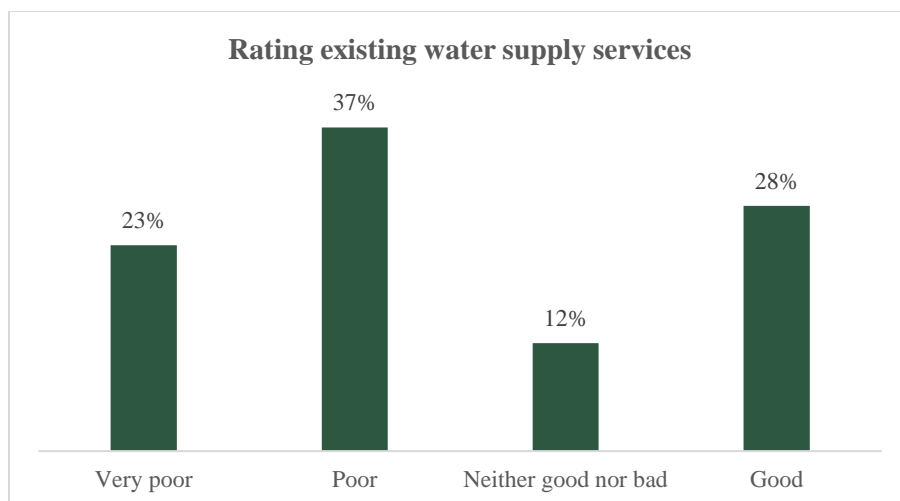


Figure 27 Rating existing water supply services

5.4.14 Government Actions on Water Provision

Respondents opined that the government should intervene in their water access predicaments by increasing the quantities and levels of water supply to the town, reducing the price of water per unit, increasing water connectivity levels and increasing public water access points respectively for 62, 11, 9 and 9 percent. Other reported measures include improving the quality of supplied water, reducing on water rationing actions, equipping water supply bodies such as Kimwasco and Tana and Athi Rivers Development Authority, clearing out outstanding water bills and providing fresh water.

Opinions on Water Supply Improvements	Frequency	Percentage
Supply should be increased	68	62%
Lower the cost of water	12	11%
Improve water connectivity	10	9%
Increase public water points	10	9%
Increase the water quality	4	4%
Reduce the water Rationing	2	2%
Equip water supply bodies	1	1%
Government to Pay the pending water bills	1	1%
Provide fresh water which is not salty	1	1%
Total	109	100%

Table 10 Opinions on Water Supply Improvements

5.4.15 Response time to damaged water infrastructure

Study participants observed that it took in excess of 14 days for water service bodies to respond to broken/leaking/damaged water supply infrastructure, mainly roads. According to 63% of respondents, it took between two and three weeks to repair damaged water infrastructure with 9% opining that it took beyond three weeks for damaged water pipes to be repaired. A proportion of 28% observed that it took between one and seven days for water provision agencies such as Kimwasco to repair destroyed water supply infrastructure. This indicates that water supply incidents were aggravated by low rate of response by water supply bodies to enhance infrastructure weaknesses and restore connections for consistent water supply to the study area.

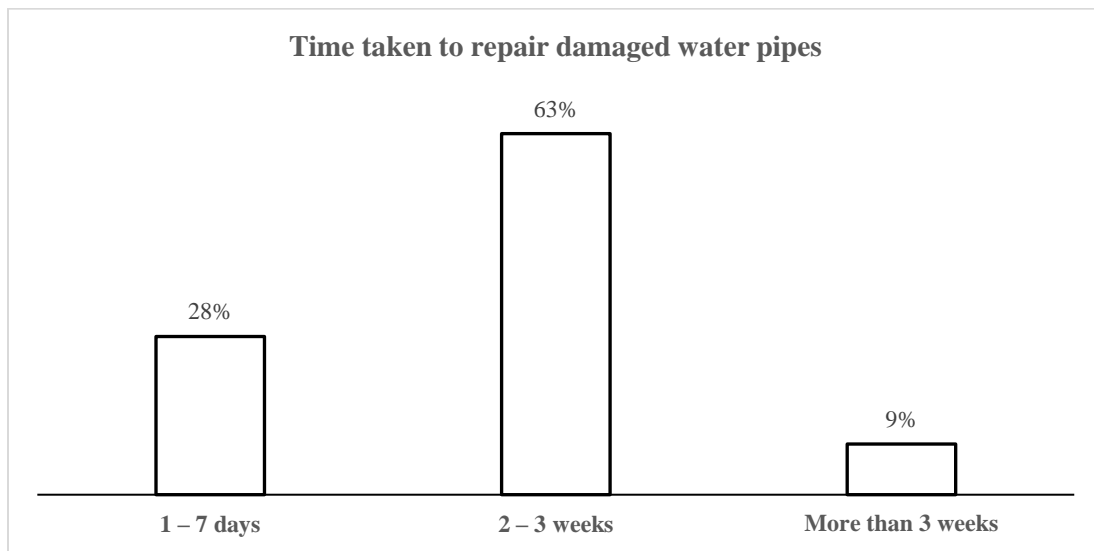


Figure 28 Time taken to repair damaged water pipes

5.4.16 Managing water dry spells

Business respondents observed that during water shortage, they adopt mechanisms that help them through the dry taps. Significant actions taken include reduction of water consumption levels, doing nothing, acquiring water from water vendors and re-using water at 39, 22, 15 and 12 percent respectively. Additional strategies employed constitute use of stored water from storage tanks, buying water from streams mainly River Tyaa and obtaining water from boreholes.

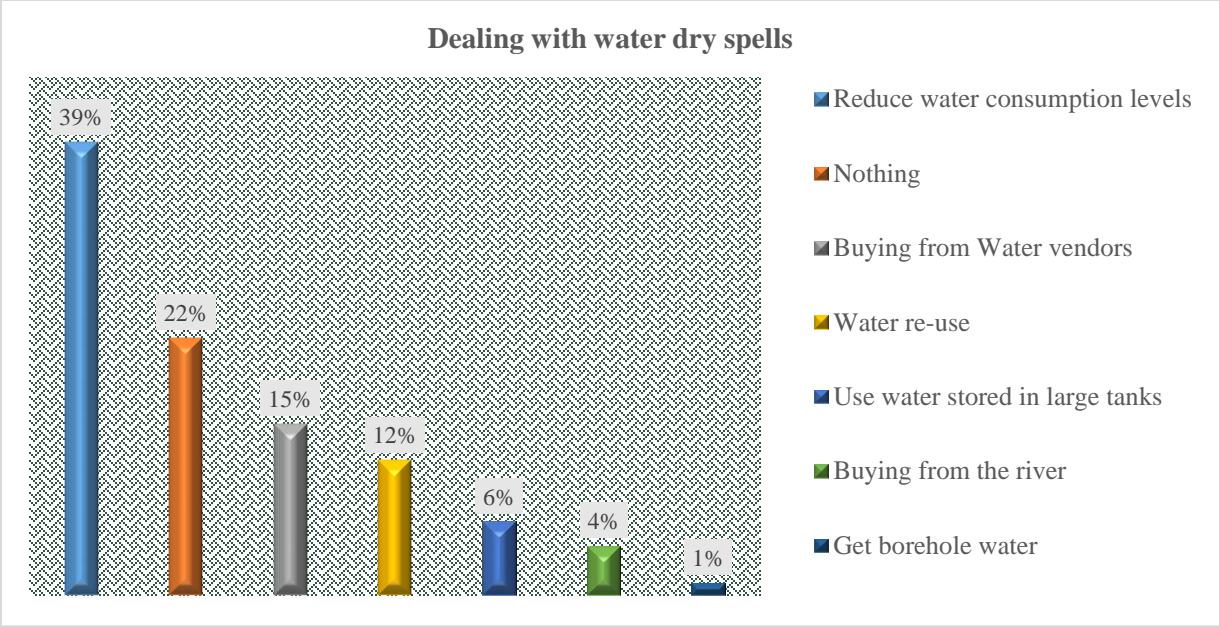


Figure 29 Dealing with water dry spells

5.4.17 Knowledge of water governance policies

Majority of business participants responded that they had no idea of any water management and governance policies summing up to 96% of all surveyed respondents. Only 4% of study participants had an idea or were aware of policies at either county or national government levels that guide the governance of water locally and nationally. All of these 4% respondents alluded being aware of the existence of water rationing policies.

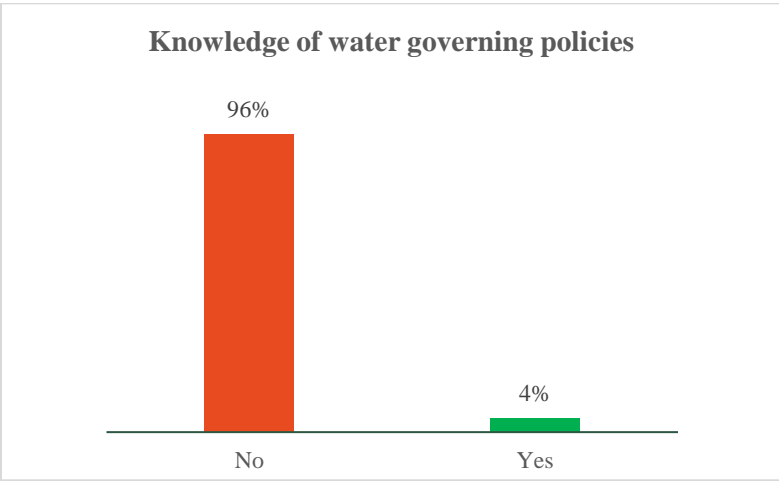


Figure 30 Knowledge of water governing policies

5.5 Water Service Providers

5.5.1 Kiambere-Mwingi Water and Sanitation Company (KiMWASCO)

Kimwasco is the main water service provider in the Mwingi town and its immediate environs. It offers services like water supply to homes through pipelines and water billing and revenue collection. The main source of water supply is Kiambere dam with 15 main storage tanks along the distribution network to Mwingi town. There are 4,752 households connected with water. Time to time Kimwasco experiences water shortage from the source but there is no alternative sources of water. The water shortage was due to low water production, machine breakdown, power outages and burst along the main lines. The key challenges in water supply included; water shortage against very high demand, old and aging infrastructure leading to high water loss, very high electricity bills, and vandalism.



Picture1 KIMWASCO water storage tank elevated at Kautha rock in the town

Source; Camera photo 2023

5.5.1.1 Water infrastructure

The water reticulation system in the town covers individual connections and water kiosks, and its status is old but working. There are 4752 users connected to piped water. The maintenance and repairs are done continuously for small lines and main line is done as soon as default occurs. The water supply does not meet the water demand due to limited abstraction capacity. To reach the unconnected water users the Kimwasco uses water bowsers (tankering).

5.5.1.2 Policy framework

The policies governing water supply and consumption included water act 2016 and WASREB guidelines. For ensuring that policies are properly enforced there is signing of service provision agreement. During the water shortage periods, Kimwasco rations water to the consumers.

5.5.1.3 Metering

There is full metering of water connection system and billing of all public sector facilities for water use. There is a meter repair/ replacement program and examination for all meters.

5.5.1.4 Pricing

The pricing structure in place for water tariffs for the company is on a scale as outlined below;

Zero – 6m³ for Ksh. 580, 6m³ – 20m³ charged per unit consumed 14m³ @ Ksh135, 20m³ – 50m³ charged per unit consumed i.e., 30m³ @ Ksh 182, 50m³ – 100m³ charged per unit consumed i.e.. 50m³ @ Ksh 232, and 100m³ – 200m³ charged per unit consumed i.e., 100m³ @ Ksh 300.

The water charges to consumers cover pumping, distribution systems operation, treatment cost, and electricity fuel. The revenue collected from water is not enough to run the company activities. There is no company's policy for water recycling and rainwater harvesting. The opportunities of

water provision and supply in Mwingi town include; very high demand against low supply and developing alternative sources.

5.5.2 Water Vendors/ Kiosks and Private Water Suppliers

5.5.2.1 Water Kiosks

There are ten water kiosks in Mwingi town (nine with kiosk attendants and one automated). They are distributed in the town with at least every estate (section of town) having a kiosk. The average water sale at kiosk is 40 cubic meters of water daily, and main source of water is Kimwasco. The source is reliable for water supply to the kiosks and sells a 20 litres jericane at Ksh. 4. The water vendors sell the water at Ksh. 30 per twenty litres jericane and covers an average of 2Km from kiosks to supply water to their customers. The challenges kiosks face while providing water services include; congestion and chaos caused by high demand of water, insufficient water supply to the customers, vandalism of pipeline that feed the water kiosks, burst along main pipelines leading to less water or no water at all, electricity blackouts, and network failure to the automated water kiosk. In the town some of opportunities that can be utilized to improve water supply include getting other alternative sources e.g., boreholes, and increase the supply at main source (Kiambere TWS). The kiosks attendants are aware of policy governing water usage and supply as Wasreb and water tariffs.



Picture 2 Water kiosks in Mwingi town

Source: Camera photo 2023

5.5.2.2 Private water suppliers

There are three private water suppliers and providers based in the town namely; Saab distributors (aquasafe), dream distributors and give power. On average they sell 20 cubic meters of water per day, and the main source is boreholes (sank by the private water suppliers). The water source is reliable for production of water unlike during scarcity when the purified and treated water is on high demand. They supply water to Mwingi town and the environs ranging from 20m to as far as 11km from Mwingi town. Mostly through tuktuks to their customers outside Mwingi town. The price of 20 litres water jerrican is varied as follows; at point the price is Ksh. 20, at delivery to customers is Ksh. 35, and for bulky sales i.e., 700 litres and above it is sold at Ksh. 10 per twenty litres jerrican. Some of the challenges faced while providing water services include poor roads, government authority and good will, high purification costs, and competition from other water vendors. They are aware of policies governing water usage and supply as standard pricing and water vending licensing. The high cost of water from private water providers is due to statutory fees enforced by Kenya Bureau of Standards (KeBS).



Picture 3 Give power water project – a private water supply plant.
Source: Camera picture, 2023

5.6 Water Governance

5.6.1 Mwingi Municipality

The municipality has the role of reporting any leakages and water misuse within the town to Kimwasco. The current water supply do not match the demand. To improve the town’s water supply there is water rationing as supply mechanism to the estate to ensure all the kiosks get enough supply for the vendors. To regulate and maintain quality by various water providers by the county government all water bowsers are licensed to ferry clean and safe drinking water, and licensing all the water vendors. The strategies in place to monitor the unaccounted for water during supply include deploying more casuals to keep scouting all over within water pipeline, and sensitization of community to report any burst. The county is involved is setting water prices through calling/ organizing public participation for stakeholders, and setting prices as per law/ act. Some challenges encountered during supply include worn out pipes leading to a lot of unaccounted for water, and high cost of power. The mechanisms in place for water provision during dry spell include; water service providers taking over the management of some boreholes to supplement piped water, and county government is championing construction of sand dams all over the county to assist in recharging underground water to boost shallow wells and boreholes.

5.6.2 Water Officer Kitui County

The water officer provides technical skills on governance through project management to improve sustainability. The water supply status is average due to rationing in the town. The initiatives set for improving water supply in the town include drilling of boreholes and earth dam constructions to boost water adequacy and supply. To ensure quality the county government conducts water quality and sampling for both shallow wells and boreholes. The county is involved in setting water prices through participation in tariff setting as per guidelines of water service trust fund. The challenges in ensuring sustainable water supply in town and county include; water supplies breakdowns are high during the drought season hence the repair and maintenance is high, poor management by project management committee, due to poor rainfall distribution in the area there is less water, and the county government receives less allocation of funds to implement more projects. The mechanisms in place to enhance water provision during dry spell include drilling of new borehole and earth dams and pipeline extension to serve the population, and community sensitization on improved methods of community water harvesting techniques.

5.7 Water Regulatory Bodies

The authority mandate is to enforce regulations formulated by WRA to ensure compliance through inspection, monitoring and enforcement. It obtains water licenses for water abstraction, water usage and determine issue, diverge water permits, and permit condition enforcement. Some challenges encountered are lack of favorable environments to implement commercialization leaves organization of privatized water supply, community managed projects are prone to maladministration by managing committees because of less monitoring by WASREB. Misconducts like poor fiscal control, lack of transparency, high operation and maintenance costs compared to revenue making if difficult for water services providers to undertake routine

maintenance and employ competent staff, low societal acceptance of interventions, and conflicts. The status of water supply in Mwingi is low as compared to water demand and supply. Mwingi town has opportunities for water provision due to its strategic location; there is high population, which creates demand for water, existence of Tyaa River, which can be utilized to construct water reservoirs. Some strategies for improving water provision comprise; strengthening customer stakeholder collaboration in water resources management, financial perception aimed at enhancing resource utilization and effective use of finances, internal procedures aimed at promoting widespread infrastructure and service delivery, and organizational capability aimed at building the recognized capacity and successful working environment.

5.8 Challenges encountered in the field investigation

Data quality issues because of raw data with errors and inconsistencies, the collected data was profiled to identify issues and data cleansing and sorting. Dealing with huge data sets for both structured and semi-structured data made initial data collection and processing complex. For this reason, I filtered sets of raw data for analysis applications. Low response i.e., a lack of motivation to responses or unwilling participants raised issues about validity of data collected. The huge data collected needed training of research assistants to create sufficient quality assurance procedures to ensure collected was accurate. The data collection actualized 315 questionnaires out of 392, which represented 82% due to big scope.

CHAPTER SIX

6.0 SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

6.1 Introduction

The chapter present conclusion of the study and revisiting the research objectives to provide a summary of the findings based on the objectives. It discusses study findings in relation to overarching theory, conceptual framework and study variables. It presents relation of findings to the work of other researchers in the field of Water Governance, as well as presenting the study recommendations and areas of further research.

6.2 Revisiting the Research Objectives

The study aim to evaluate the contributions of governance to water availability in Mwingi town, with the particular objectives of the study been:

1. To investigate systems of water supply in Mwingi town.
2. To analyse the state of water governance in Mwingi town.
3. To proffer solutions to sustainable water reliability in Mwingi town.

6.3 Summary of Findings

6.3.1 To investigate systems of water supply in Mwingi town

The study addressed systems of water supply by analyzing the water challenges in Mwingi town as follows: Long distance to collect household water averages at 650m, which takes longer time to collect water. The minimal water connections to the households reduces chances of water access, weekly water scarcity indicates an adverse water scarcity in town. The main alternative water source is the vendors who mostly depend on water from Kimwasco water kiosks and few from private boreholes and Tyaa River (neither treated nor purified). Many households and water users

including hotels and restaurants did not harvest rainwater due to lack of harvesting mechanisms. Inadequate water for running the activities within the premises due to low water quantities and rationing. Water acquisition is expensive because the water is mostly from the vendors and most of water users are not connected to KIMWASCO main source. Salty water mostly from vendors drawing water directly from the river or boreholes and lack of purification. High transport cost and means due to the long distance covered to acquire water. High electricity bill because of pumping water from the source to pipes and storage tanks. A lot of revenue and finances is set aside for offsetting bills hence minimizing the capacity of water supply. Less revenue generated from water is insufficient to run the company's affairs and adequately respond to emergencies related to water supply e.g., breakages.

6.3.2 To analyse the state of water governance in Mwingi town

Kimwasco is the major supply of water in Mwingi town. The mechanisms used by the water users to reduce water wastage include avoiding unnecessary cloth washing and turning off unused water taps. The water expenses for the users was rated to be expensive on monthly average of Ksh. 1800. This was inclusive of total monthly water budget for all household activities. The main source of business water was water vendors since most of them lack private water connections from Kimwasco. This is orchestrated by constant water shortages and the vendors participate as major water suppliers to the business premises.

Measures for reducing water wastage included recycling water, educating employees on water conservation, turning off unused water taps, and installing low-flow showers for guesthouses. The water supply services were rated to be poor for business premises based on reality that main supply of water is water vendors. The government actions on water provision include water supply improvements, lower the cost of water, improve water connectivity, increase public water points,

increase water quality, reduce the water rationing, equip water supply bodies, payment of pending water bills, and provide fresh.

The infrastructure which, is key for water supply and distribution, take a minimum of a week to respond to and this leads to serious water loss and minimized supply. The measures taken during the dry spells period include reducing water consumption levels, buying water from vendors, water re-use and getting from river and private boreholes. The majority of population interviewed were not aware of any water policy in place to govern water usage and supply.

The quality of water supplied by Kimwasco was rated to be good which indicates that the little water from the source is purified and treated well. Constant water rationing because the demand is high against a very low supply. This mechanism helps the water users to reduce misuse and be innovative in better ways of water usage.

Water vendors; are licensed to enhance water supply to the residents without piped water connection and during the dry spell seasons. Water demand; this creates room for alternative water supply due to guaranteed consumption of water to residents. This requires private actors in water supply and distribution, and innovative water treatment mechanisms because the ground water is saline.

Private water provision; there is a great demand for water which needs adequate supply, especially from the private water companies (privatization). Harvesting rainwater, the residents have an adequate capacity to harvest rainwater. Storage and harvesting mechanisms should be improvised to create room for alternative water provisions and storage for use during dry seasons. Drilling boreholes and dams; the area has an advantage of topography which be utilized to create room for dam constructions and boreholes.

6.3.3 To Proffer Solutions to Sustainable Water Reliability in Mwingi town

The water sector to be adequately funded for both national and county governments. The water demand and scarcity in Mwingi town can be torn down by an alternative sourcing or piping from the main dam at a cost of Ksh. 2 billion. Installation of more storage tanks with large capacity to store more water.

The water usage strategies to be maximally employed because the area is naturally arid. This makes the water scarcity acute if no deliberate actions taken towards this.

The public private partnership due to existence of more consumers and private providers the government can collaborate to enhance the water supply in the town.

Having quick response towards breakages and vandalism in water pipes. This helps in curbing water loss through the unaccounted for water. The water is adequately metered but breakages can lead to adverse water loss leading to loss of revenue.

The construction of a mega dam at Tyaa River as an alternative water source for Mwingi town residents. This will complement the water supply by KIMWASCO and have a solution of water access, quality and quantity. This dam can be approximately 200 cubic meter with treatment and purification plants and a water tower tank for distribution to all residents in Mwingi town.

Creation of Water Resource Users Association (WRUA) specifically addressing water issues of catchment areas around Mwingi municipality. This includes mountains and rivers, which lead to Tyaa River as main alternative source of water for Mwingi town.

Formation of a formal water development committee on contract, with inclusion of technical personnel. This will help in streamlining water provision, supply and consumption to the residents and minimize the leadership issues at committee level for most water projects.

Embracing water conservation tips including Bathrooms; taking short showers or re-using bath water for watering plants or garden. Kitchen and laundry; avoid using running water for cleaning instead use dishes and basins for washing and cleanings. Use appropriate water levels in washing machines. Outside; sweep driveways and sidewalks instead of hosing off, for swimming pools use appropriate technologies, commercial carwash because they recycle water. Avoid buying recreational water toys that require huge amounts of water. For equipment; repair all leakages in time, mount ultra-low flow toilets, and install low-flow showerheads, and using a high efficacy washing machine saving over 50% in water use. Apply efficient watering measures for landscaping on watering, planting, and maintaining.

6.3.4 The Relation of Objectives and Overarching Theory

The study's overarching theory is Systems theory supported by Sustainability theory, Actor-Network theory, Collective action theory and government as network model. The study objectives of water challenges supply and its relation to governance issues and concerns had a translation to water opportunities, which when utilized can lead to sustainable water provision in the town. The water management and governance is a systems operating from spectrum of actors, water provision, supply, and consumption. The water infrastructure as an engineering service needs adequate attention from the technical team for its effective functionality. The multisector phenomena of water governance once harmonized will improve water provision leading to sufficient supply and reliability in the town. The systems theory sufficiently and accurately supported the study and its findings.

6.4 Revisiting Study Proposition

The research proposition was that there is no clear interventions for governance capacity through KIMWASCO to provide water to the residents, and handling water provision, supply and management. This proposition adequately supported by the research findings.

6.5 Conclusion

This study has produced information useful to enhance water supply and distribution in Mwingi town. The insights of consumers on water shortages, scarcity, cost, connection, and quality concerns substantially aid KIMWASCO and Kitui county government to address the concerns of water and governance. The rapidly increasing population in Mwingi town increases demand hence straining the capacity of KIMWASCO to provide and supply adequate and quality water to the residents. To achieve the study focus on sustainable water solutions in Mwingi town the opportunities should be well utilized, and the raised governance issues and concerns addressed appropriately. This will mitigate all the water challenges on supply, distribution and provision in the township. The main recommendations of the study towards sustainable water provision in Mwingi town and any other area of similar conditions in Mwingi are discussed in line with objectives, underlining theories and conceptual framework.

6.6 Recommendations

The sustainable water governance interventions geared towards sustainable water solutions are explicitly discussed in this section. This is by analyses the interventions towards effective water governance for urban areas in developing nations, and urban areas facing adverse water scarcity. It creates an understanding on performance of existing water institutions, policies and governance instruments and possible amendment where need be. The interventions involves of connecting actions with current regulations while setting up accountability process to track progress over time.

Distinct and clear allocation of roles and responsibilities. Distinctive policies in making, operation, management and regulation promotes harmonization across responsible authorities. Water sector fragmentation is across numerous actors, irrespective of constitutional and institutionalized setting for water governance.

Appropriate scaling for water management; this is within integrated basin control to replicate local conditions by nurturing synchronization between diverse scales, and predominantly, water field is profound to scaling issues. Water logics and transboundary frontier administrative limits. Management of water services happen in several scales, for environmental and political extents. For Austria with three huge transboundary amounts of river, catchment applies basin governance instead of catchment-oriented governance for effective coordination and cooperation at basin level. The diversely inclusive actions in programme actions are assigned to authority on scale of involvement (OECD, 2018).

Adapt to level of water complexity capacity; the authority responsiveness to multifaceted water encounters to be met, then set capabilities obligatory for carrying out responsibilities. The practical skills development and accessible staff set prerequisites for operationalization water policy. Government face essential concerns while decentralizing water policy and presumptuous responsibilities allied with fervent tasks. Mismatch between necessary capacities assumes water responsibilities in both technical and bureaucratic undertakings. Undertaking capacity building and institutionalized support is pertinent at all levels for conservative water policies.

Mobilize water finance efficiently; authority arrangements to organize water finance and apportion resources proficiently, transparently and in time. Financial insufficiency and undue revenue is an obstacle in executing water policies in urban areas. The transparency among diverse governance levels is a significant enabler to effect and align financial needs.

Implement and enforce water regulation; guaranteeing sound framework control for operative adoption in pursuit of collective benefits. Inclusive, explicate and reliable regulatory framework instituted on effective regulation of policies and institutions are vital for setting policy outcomes. Espousing various regulatory frameworks to match performance of regulatory functions in relation to water services (OECD, 2019).

Promote innovative water governance practices; embracing and implementing inventive practices of governance for authorities and germane stakeholders. The importance of improvement in water sector supports modification towards sustainable water safe features. The innovation level enactment and upgrade is effective subject to enabling governance frameworks. To implement inventive systems there is extensively recognized necessity for enhanced water governance across numerous values.

Mainstream integrity and transparency; promoting tenets of good governance of integrity and transparency across water policies, institutions and governance frameworks. Both are critical for building and reinstating leadership trust and water institutions. Upholding integrity and transparency requires authorities back up to empower institutional atmosphere for taking integrity measures of equity, efficacy and sustainability.

Upholding stakeholder engagement; for improved contributions towards policy design, execution and adoption. This increases the public ownership of set policies due to their direct engagement in policy formulation. Water sector engages plethora of communal, private and non-profit participants. These categories with government, investors among others have stake in setting predetermined outcome of water policy whom engagement should be priory sought.

Monitor and appraise water policy and governance; to conduct continuous assessment and evaluation of water policy when suitable and share outcomes with public for collective adjustments when need be. Evaluation helps to determine workability of water policies and intuition from experience for enhancing future practice. For instance, Ireland expansively reviewed and assessed the magnitude of water policy outcomes in 2010 & 2014.

6.7 Areas of Further Research

This study proposes additional areas of research as follows:

- i. Effects of public private partnership in water provision in study area.
- ii. Utilization of storm water for sustainable water supply in study area.
- iii. Sustainable water infrastructure in the study area
- iv. Water scarcity issue and environment in the study area.

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ANNEXURES



University of Nairobi

FACULTY OF BUILT ENVIRONMENT AND DESIGN

DEPARTMENT OF ARCHITECTURE

**CONTRIBUTIONS OF GOVERNANCE TO WATER AVAILABILITY IN MWINGI
TOWN**

WATER USERS.

a) RESIDENTIAL HOUSEHOLD QUESTIONNAIRE

Note: The information obtained through this questionnaire is purely for academic purposes and shall be treated in confidence and anonymity.

General information

Date.....

Questionnaire No.....

Respondent name.....

Locality (area name).....

Please tick where appropriate and write in available spaces where applicable.

1. Sex:

Male

Female

2. Age in years

- A. 18-25 B. 26-35 C. 35-45
D. 45-55 E. Above 55

3. Marital status

- A. Married B. Separated C. Widowed
D. Divorced E. Single

4. Household size

- A. 1-4 B. 5-8 C. More than 8 people

5. Level of education of the respondent:

- A. Primary B. Secondary C. College
D. University E. No formal education

6. Main occupation of household head

- A. Employee (formal) B. Unemployed C. Retiree
D. Student E. Self-employed F. Business man/woman

a) Water Supply and Services

7. What is your main source of domestic water supply?

- A. KiMWASCO water B. Communal yard tap in plot C. Public borehole
D. Private borehole E. Water vendors F. River/stream
G. Water kiosk H. Shallow well I. Rain water harvesting
J. Others, specify,

.....

.....

8. Do you have a household water connection?

A. Yes B. No

If yes, what is the frequency of supply?

A. Daily B. 2 times per week

C. Once per week D. 3 times per week

9. Approximately, how many litres of water do you use per day?

A. 1-20 B. 21-60 C. 61-100 D. More than 100

10. How often do you experience a water shortage in your household?

A. On a daily, base B. On a weekly, base C. On a monthly base

D. Every three months or more (specify)

11. Do you have any other alternative source of water supply in case of shortage?

A. Reserve tanks B. Wells C. Water vendors D. No other source

12. What is the distance from the house to the water source?

A. Less than 20m B. 21 – 100m C. 101 – 250m

D. 251 – 500m E. 501 – 1000m F. Above 1001m

13. Do you harvest rainwater? Yes No

If yes, where do you store the water?

A. Buckets/Drums B. Galvanized iron sheet tanks

C. Masonry/Concrete tanks D. Plastic water tanks

E. Others, Specify

If no, what are the reasons for not harvesting rainwater?

.....

.....

14. What is the status of your domestic water supply in terms of quality?

A. Very good B. Good C. Poor D. Very poor

15. What measures do you use to reduce water usage and wastage in your households?

A. Turning off water taps when not in use

B. Taking less time in the shower

C. Educating family members on importance of water conservation

D. Avoiding washing of clothes unnecessarily

E. Repair indoor leakages

F. Not washing dishes under running tap

16. How much do you spend on domestic water per month?

A. Less than Ksh. 500 B. Ksh. 501 – 1000

C. Ksh. 1001 – 3000 D. Above Ksh. 3000

17. Rate the current water price per unit

A. Cheap B. Affordable C. Expensive D. Very expensive

18. How would you rate the existing water supply services?

A. Excellent B. Good C. Bad D. Poor

Thank you for your time.

**b) QUESTIONNAIRE TO BUSINESS ENTERPRISES AND INDUSTRIES
(Hotels and Restaurants, Commercial Premises and Industrial)**

Note: The information obtained through this questionnaire is purely for academic purposes and shall be treated in confidence and anonymity.

General information

Date

Questionnaire No.....

Respondent name.....

Position in the organization.....

Locality (Area names).....

Name of business.....

1. What is the source of water in your business?

- Municipal water public borehole private borehole
Water vendors river/stream water kiosk
Shallow well rain water harvesting other, specify

2. How many litres of water do you use per day?

- 1 – 100 101 – 300 301 – 600 601 – 1000
1001 – 5000 5000 – 10000 more than 10,000

3. How often do you experience a water shortage in your business?

- On daily bases on a weekly base on a monthly base
 Every three months or more (please specify)

4. Do you have any other water supply in case of shortage?

- Reserve tanks wells water vendors no other source

5. Do you harvest rainwater? Yes No

If yes, where do you store the water?

Buckets/Drums

Galvanized iron sheet tanks

Masonry/Concrete tanks

Plastic water tanks

Other, specify.....

If no, what are the reasons for not harvesting rainwater?

.....

.....

.....

6. Rate the quality of water supplied in your business

Very good

Good

Poor

Very poor

7. What are the problems you encounter in accessing water in your business?

.....

.....

8. What measures do you use to reduce water usage and wastage in your business?

Turning off water taps when not in use

installing low flow showers

Educating employees on water conservation

recycling water

Metering and sub metering

water audits

9. How much do you spend on water per month?

A. Below 2000

B. 2000 – 5000

C. 5001 – 10000

B. 10001 – 20000

E. Above 20000

10. Rate the current water price per unit

A. Cheap

B. Affordable

C. Expensive

D. Very expensive

11. How would you rate the existing water supply services?

A. Excellent

B. Very good

C. Good

D. Bad

E. Poor

12. In your own view what do you think the government should do to improve on water supply to the residents of Mwingi town?

.....
.....
.....

13. How long does it take for the water pipes and infrastructure to be repaired in case of damage?

- A. 1 – 7 days B. 2 – 3 weeks C. More than 3 weeks

14. What mechanisms do you employ during the dry-spell periods?

.....
.....
.....

15. Are you aware of any policy governing water usage and provision in Mwingi town? Or generally in Kenya.

- A. Yes B. No

If yes, what are the policies?

.....
.....
.....

Thank You for Your Time

WATER SERVICE PROVIDERS

a) INTERVIEW SCHEDULE FOR WATER SERVICE PROVIDERS (KIMWASCO)

Note: The information obtained through this questionnaire is purely for academic purposes and shall be treated in confidence and anonymity.

General information

Date of interview.....

Questionnaire No.....

Respondent name.....

Position in the organization.....

1. What kind of water services do you offer in the township?

.....
.....
.....

2. What is the main source of water that you provide to Mwingi town residents?

A. Dam B. Boreholes C. Rivers D. Others, specify

3. How many households have you connected with water?

.....

4. How many water storage tanks does the water distribution network have?

.....

5. Do you experience any water shortage from the source?

Yes No

If yes, what alternative sources do you have to ensure continuous water supply?

.....
.....

6. What do you think causes water shortage?

.....
.....
.....

7. What are the key challenges in water supply faced?

.....
.....
.....

Water infrastructure

8. What is the scope of water reticulation system in the township?

.....

9. What is the status of the existing water supply rectification system?

.....

10. How many users are connected to piped water?

.....

11. How regularly do you maintain/ repair the water pipes?

.....

12. Do you think the supply of water meets the demand for water?

A. Yes B. No

If no, what are the possible reasons?

13. How do you reach the unconnected water users?

Policy framework

14. What are the policies governing the water supply and consumption?

.....

.....

15. How do you make sure the policies set are properly enforced?

.....

.....

16. Do you have specific policies during water shortage periods or during prolonged dry-spells?

Yes

No

If yes, please specify.....

.....

Metering

17. Is your systems 100% metered?

Yes

No

If no, what is not metered.....

18. Are all public sector facilities billed for their water use?

Yes

No

If no, what are reasons for not billing them?

.....

.....

.....

19. Do you have a meter repair/replacement program?

Yes

No

Pricing

20. What pricing structure is in place for water tariffs for the company?

.....

21. Which of the following items are covered by the price of water charged to customers?

A. Pumping

B. Distribution systems operation

C. Treatment cost

D. Electricity fuel

22. Is the revenue collected sufficient for the running of the company activities?

.....

23. Does the company has a policy in place for water recycling and rain water harvesting?

.....

.....

.....

24. What are opportunities in water provision and supply in Mwingi town?

.....

.....

.....

Thank you for your time.

INTERVIEW SCHEDULE FOR WATER SERVICE PROVIDERS (WATER VENDORS/KIOSKS, PRIVATE WATER SUPPLIERS AND COMMUNITY BASED ORGANIZATION)

Note: The information obtained through this questionnaire is purely for academic purposes and should be treated in confidence and anonymity.

General information

Date of interview.....

Questionnaire No.....

Respondent name.....

Locality (area name).....

1. How many litres of water do you sell per day?

.....

2. What is the water source?

.....

3. Is the source reliable?

.....

4. What is the maximum distance covered while supplying water to customers?

.....

5. What is the price of 20 litre jerican?

.....

6. What challenges do you face while providing water services?

.....

.....

7. What are the opportunities that can be utilized to improve water supply in the town?

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.....
.....
.....

8. Are you aware of any policy in place to govern/control water usage and supply?

Yes No

If yes, specify them

.....
.....
.....

Thank you for your time.

**WATER REGULATORY BODIES
SEMI-STRUCTURED INTERVIEWS FOR WATER RESOURCE AUTHORITY**

Note: The information obtained through this questionnaire is purely for academic purposes and shall be treated in confidence and anonymity.

General information

Date of interview.....

Questionnaire No.....

Respondent name.....

Position in the organization.....

1. What role(s) does the authority play in water governance?

.....
.....

2. What are the challenges faced when implementing your mandate?

.....
.....
.....

3. What is the status of water supply in Mwingi Town?

.....
.....
.....

4. What strategies are there to regulate water usage and control wastage?

.....
.....
.....

5. What opportunities does the area possess towards water supply and distribution?

.....
.....
.....

6. What strategies are in place to improve water provision in the town?

.....
.....
.....

7. What are the key policies regulating water use and supply in the town?

.....
.....
.....

8. Are there water users associations in Mwingi town area?

Yes No

If yes, what is their role and contribution in water governance?

.....
.....
.....

Thank you for your time.

**WATER GOVERNANCE
SEMI-STRUCTURED INTERVIEWS FOR WATER OFFICER KITUI COUNTY &
MWINGI MUNICIPALITY**

Note: The information obtained through this questionnaire is purely for academic purposes and shall be treated in confidence and anonymity.

General information

Date of interview..... Questionnaire No.....

Respondent name..... Position in the organization.....

1. What is the role of your office in water supply towards water governance in Mwingi Town?

.....

.....

2. What is the current water supply in the township?

.....

3. What initiatives have been put in place to improve water supply in township and county?

.....

.....

4. How does the county government regulate and ensure water quality is maintained by various service providers?

.....

.....

5. What strategies are in place to monitor the unaccounted for water during supply?

.....

.....

6. Does the county have a policy in place for rainwater harvesting?

.....

.....

.....

7. Is the county involved in setting water prices?

Yes

No

If yes, what procedure is involved?

.....

.....

8. Do you have a policy for the water governance within Kitui County?

.....

9. What challenges are there in ensuring sustainable water supply in townships and the county at large?

.....

.....

.....

10. What are the mechanisms in place for water provision during the dry spell/prolonged drought?

.....

.....

Thank you for your time.

SEMI-STRUCTURED INTERVIEWS FOR MINISTRY OF WATER NATIONAL GOVERNMENT – TECHNICAL OFFICER

1. What are the objectives of the country’s water policy?

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.....
.....

2. What is the ministerial budgetary allocation to water sector?

.....

3. What are the challenges the ministry has faced in enhancing water governance?

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.....
.....

4. What are the measures by the ministry to reduce non-revenue water in the country?

.....
.....
.....

5. What institutional reforms has the ministry initiated to ensure water utilities are financially sustainable.....

.....

6. What are the policies governing water supply and distribution in the country?

.....
.....
.....

7. Does the ministry conduct public awareness campaigns to sensitize the citizens on importance of water conservation?

Yes No

If yes, which outreach program?

A. Media adverts (Tv, Radio, Newspaper and social media)

B. Public awareness campaign in the town

C. Water conservation workshops for the general public

D. Water conservation seminars in schools

8. What are the possible opportunities towards water provision in urban areas?

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.....

.....

9. What are challenges of water supply at national level?

.....

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.....

10. In your own view, what changes or additional recommendations can be made for the water policy to effectively enhance water governance

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Thank you for your time.

APPENDIX: Letter of Introduction from Department of Architecture (UoN)



UNIVERSITY OF NAIROBI

Faculty of Built Environment and Design
DEPARTMENT OF ARCHITECTURE

E- mail: architecture@uonbi.ac.ke

P.O. BOX 30197,
Nairobi, Kenya
Telephone: 020-4913519
Telegrams: Varsity.

Our Ref: UON/FBED/Arch/39186/21

Date: 7th February, 2023

TO WHOM IT MAY CONCERN

RE: MOSES KITEME REG. NO. W50/ 39186/2021

This is to confirm that the above named is a bona fide student pursuing Master of Urban Management degree in the Department of Architecture, University of Nairobi. He is undertaking a project entitled "*Enhanced Governance Towards Solving Water Scarcity and Challenges in Mwingi Town*".

Mr. Kiteme wishes to collect data for his project. We are thus requesting you to give him some of your valuable time and respond positively to his enquiries, provision of drawings, maps, etc as may be required. This is for academic purposes only.

Any assistance accorded to him will be highly appreciated.

Yours sincerely,


CHAIRMAN
DEPARTMENT OF ARCHITECTURE
UNIVERSITY OF NAIROBI

Arch. Musau Kimeu
CHAIRMAN,
DEPARTMENT OF ARCHITECTURE

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