ASSESSMENT OF SOURCES OF WATER FOR USE BY NON-RESIDENT STUDENTS OF THE UNIVERSITY OF KABIANGA, KENYA, AND THE IMPLICATIONS ON STUDENTS` UNIVERSITY LIFE

NKONGE J. NDAKU

A THESIS SUBMITTED TO THE BOARD OF GRADUATE STUDIES IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE CONFERMENT OF THE MASTERS OF SCIENCE DEGREE IN ENVIRONMENTAL PLANNING AND MANAGEMENT OF THE UNIVERSITY OF KABIANGA

UNIVERSITY OF KABIANGA

OCTOBER 2024

DECLARATION AND APPROVAL

Declaration

I declare that this thesis is my original work and has not been presented before for the conferment of a degree or award of a diploma in this or any other institution.

SIGN_____ DATE _____

NKONGE J. NDAKU

PGC/EVA/0003/17

Approval.

This thesis has been submitted with our approval as University Supervisors:

SIGN_____DATE_____

DR. ANN SIETINEI

Dept. of Agroforestry, Environmental Studies, and Integrated Natural Resources Management

University of Kabianga

SIGN_____DATE_____

DR. JOB K. NGETICH

Department of Environmental, Planning, Sustainability, and Geoinformatics.

University of Eldoret

COPYRIGHT

DEDICATION

I am pleased to dedicate this thesis to my family and my close friends, who have been an inspiration throughout my academic studies.

ACKNOWLEDGEMENT

ABSTRACT

The immense increase in residential developments around universities to provide private accommodation for the rapidly growing university student population has constrained the provision of a safe, clean, and sufficient water supply. The main objective of the study was to assess the water supply sources for University of Kabianga off-campus students residing within Kabianga University town. Among its specific objectives were establishing the sources of water available for non-resident students of the University of Kabianga, determining the water consumption patterns among non-resident students of the University of Kabianga and establishing the challenges for accessing water for non-resident students of the University of Kabianga. Undertaking this study will help in providing solutions to mitigate water supply problems and their resultant impacts, the key being health risks within the non-resident students` hostels. The findings of this study will provide a basis for the provision of a sustainable water supply of adequate quality to non-resident students` hostels at the University of Kabianga and inform the stakeholders of appropriate measures that should be put in place to ensure adequate water supply to their tenants. The study relied on a descriptive survey design. Its target population was the non-resident students (673 students) of the University of Kabianga, from whom a sample size of 251 students was selected. 53% of the participants were males, while 47% were females. Simple random sampling was used to select the participants, while random sampling was utilized to choose the study's private hostels (15 hostels since they had a large population of students). The tools for data collection included questionnaires, key informant interviews, photography and an observation guide. The collected data was analyzed using Statistical Package for Social Sciences (SPSS) to generate descriptive statistics and other statistical outputs presented using tables, pie charts, and graphs. According to the findings, most respondents (68%) relied on rainwater during the rainy season. Most students (46%) relied on wells/boreholes, while 44% relied on private vendors during the dry season. Most (69%) non-resident students of the University of Kabianga experienced severe water shortages, especially during the dry seasons. The per capita household water consumption is 40.9756lpcd (sd= 18.87292), thus indicating water inadequacy since one should use an average amount of 50L per day. Most respondents (77%) indicated that the cost of water was very high during the dry season, with prices of a 20-litre Jerrican of water -selling between 15-25 Kenya shillings, thus rendering it unaffordable. Moreover, water prices fluctuate depending on the season and demand for water. It was also established that the challenges the students encounter while accessing water affect their education, daily expenses, and personal health (mental and physical). In addition, a lot of time (approximately 30-60 minutes daily) that they could have used to do part of their academic work is wasted since the water sources are unreliable. Therefore, a safe and more reliable water source suitable for all uses, like piped water, is required to ensure the health and safety of the non-resident students of the University of Kabianga. Further, the landlords should partner with the water vendors to establish a fair water price for their tenants to avoid student exploitation, especially in dry seasons when the costs are increased depending on the demand, as the cultural water management theory recommends.

TABLE OF CONTENTS

LIST OF TABLES

xiii

LIST OF FIGURES

LIST OF PLATES

LIST OF ABBREVIATIONS & ACRONYMS

CIDP   County Integrated Development Plan

EIA   Environment Impact Assessment

EMCA   Environment Management and Coordination Act

GDP   Gross Domestic Product

GOE   Government of Ethiopia

GTP   Growth Transformation Plan

KEWASCO   Kericho Water and Sanitation Company

LBDA   Lake Basin Development Authority

LPCD   Litres per Person (capita) per Day

MDGs   Millennium Development Goals

MOU   Memorandum of Understanding

MOWI   Ministry of Water and Irrigation

MPHS   Ministry of Public Health Services

NEMA   National Environment Management Authority

NGOs   Non-governmental Organizations

NWSS   National Water Service Strategy

OWNP   One WASH National Program

PPP	Public Private Partnership
SDGs	Sustainable Development Goals
SPAs	Service Provision Agreements
SPSS	Statistical Packages for Social Sciences
SSPs	Small Service Providers
TILILWASCO	Tililbei Water and Sanitation Company
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNICEF	United Nations International Children's Emergency Fund
UoK	University of Kabianga
WARMA	Water Resources Management Authority
WASH	Water Sanitation and Hygiene
WASREB	Water Services Regulatory Board
WHO	World Health Organization
WIF	Wash Implementation Framework
WRCF	Water Resources Constraint Forces
WSB	Water Service Board
WSP	Water Service Providers

WSRS   Water Sector Reform Secretariat

WSTF   Water Service Trust Fund

DEFINITION OF TERMS

Non-resident students/ Off-campus students   Students who have acquired private accommodation in privately owned hostels outside the University-Main Campus

Public-private Partnership   A framework through which government agencies and private-sector firms work together to build and operate projects like housing, public transportation, convention centers, and water schemes

Sustainability   Natural resource utilization in a manner that meets the present generation`s needs while ensuring that future generations will use the same resources to meet their needs as well

University/college Town   A community (often a separate town or city) dominated by its university population.

Water Quality   The chemical, biological, and physical properties of water concerning how suitable it is for a particular purpose like swimming or drinking.

CHAPTER ONE

INTRODUCTION

1.1 Introduction

This introductory chapter presents the study`s background, statement of the problem, general objective, specific objectives, research questions, justification and significance of the study, scope as well as study assumptions.

1.2 Background of the Study

Approximately one-third of the global population resides in countries experiencing moderate to high water stress. Additionally, Kenya is categorized as a chronically water-scarce country by the United Nations. Further, only 30% of those living in urban areas in Kenya are not connected to the existing water supply systems (Davis et al., 2017). A significant percentage of the Kenyan population relies on alternative sources of water. Of the alternatives, running water courses like rivers or domestic groundwater wells form their primary source. Regardless, the majority of those water sources are of impaired quality and seasonal (Cherunya et al., 2015)

Achieving a sustainable water supply for the entire population is key to meeting Sustainable Development Goals (SDGs) (Goals 3 &6). Approximately 60% of the urban population in Kenya experiences sustainable access to clean and safe drinking water. However, only 20% of the urban poor, who constitute approximately half of Kenya's urban

population, have access to sustainable, clean and safe drinking water (Cherunya et al., 2015). As a result, this increases the risk of increased waterborne diseases within the population. This resonates with the finding by WHO (2011) that claims that over five million annual deaths are water-related diseases. Therefore, better water supply management can lead to the realization of people's good health and well-being globally.

In recent years, Kenyan Universities have experienced significant growth in the number of student enrolments, thus leading to a high demand for student accommodation. In the 2022 Economic Survey report by the Kenya Bureau of Statistics (KEBS), the number of students enrolled in Universities increased from 546,699 students in the 2020/21 academic year to 562,066 students in 2021/22. University of Kabianga enrollment was not an exception since it saw an increase in student numbers from 6,482 students in the 2020/21 academic year to 6,647 students in the 2021/22 academic year (KEBS, 2022). However, student enrollments are beyond the university's available bed capacity, forcing universities to run residence halls commercially, where students pay for university accommodation or look for alternative accommodation outside university precincts. As a result, universities have sought to engage with private investors in student accommodation development to ensure that adequate hostels are available to accommodate non-resident students. This has resulted in the mushrooming up of housing units of low standards without commensurate infrastructure services such as water and sanitation. Most developers focus more on making profits from their hostels than on the well-being of their tenants, who are the students.

According to Chepkener (2018), private accommodation for undergraduate students has triggered a debate among various stakeholders. Such concerns relate to the well-being of

the non-resident students, such as security and the provision of adequate and clean water supply. Most private accommodation hostels are characterized by inadequate water supply that forces students to buy water of unknown qualities from private vendors. Therefore, there is a need to conduct studies within areas where students are accommodated to determine if their housing facilities are adequate for the well-being of the students. Ensuring sustainable access to safe and clean water would significantly enhance health, motivate more students to enrol and excel in educational programs, stimulate economic productivity, and protect their dignity (WHO, 2011). This study, therefore, was aimed at assessing the sources of water used by non-resident students of the University of Kabianga in their housing units off-campus and the resultant perceived implications on the students` quality of life within Kabianga University town, Kenya. The study`s findings will be helpful in policy formulation.

1.3 Statement of the Problem

Prior to de-linking university admission and accommodation, it was within the university's mandate to provide accommodation to students. The university accommodation facilities were built following specific standards to ensure the well-being of the students. The government's decision to de-link students' accommodation and catering from academic programs to increase the number of students enrolled in public universities has led to a phenomenal growth in student numbers, thus demanding more accommodation facilities. As a result, universities have collaborated with private investors through Public Private Partnerships (PPPs) to provide student accommodation (Ngochi, 2020). However, most developers` focus has been on making profits from their hostels rather than on the well-

being of their tenants. This has led to various challenges like water rationing, which eventually worsens, especially in the dry seasons of the year, leading to students buying water of unknown quality, thereby putting their health at risk. University of Kabianga's non-resident student population is not an exception to such challenges due to rapid growth in the development of housing units.

The lack of a functional municipal conventional water supply forces students to buy water of unknown quality from private vendors at high prices. Moreover, water scarcity affects learning since students spend much more time looking for water than learning, which could contribute to poor performance and attendant prospects. Article 43 of the Kenyan Constitution (2010) protects everyone`s fundamental right to access adequate water. However, the reality for non-resident students of the University of Kabianga is far from their entitlements by the Kenyan Constitution. Therefore, this study sought to assess the sources of water used by non-resident students of the University of Kabianga and the resultant perceived implications on the students` quality of life within Kabianga University town, Kenya.

1.4 General Objective

The study's primary objective was to assess the sources of water used by non-resident students of the University of Kabianga and the resultant perceived implications on the students` quality of life within Kabianga University town, Kenya.

1.5 Specific Objectives

The following objectives guided this study;

i. To establish the water sources available for use by non-resident students of the University of Kabianga

ii. To determine water consumption patterns among non-resident students of the University of Kabianga.

iii. To establish the challenges associated with water access among non-resident students of the University of Kabianga

1.6 Research Questions

The study aimed to answer the following research questions;

i. What water sources are available for non-resident students of the University of Kabianga?

ii. What are the water consumption patterns among the non-resident students of the University of Kabianga?

iii. What are the challenges for non-resident students of the University of Kabianga in accessing water?

1.7 Justification of the Study

Water supply inadequacy may lead to health risks due to the dependence on other water sources of unknown qualities. According to Article 43 of the Constitution of Kenya (2010 every citizen, including students, should have adequate access to water. Moreover, students may not only incur a lot of expenses while buying water from private vendors at high prices but also waste a lot of time while sourcing water rather than studying. In general, the living standards of students within the hostels may deteriorate over time if adequate clean water

is not provided. Failure to undertake this study could exacerbate water supply problems and their resultant impacts, the key being health risks within the non-resident students` hostels. D'Odorico& Rodriguez-Iturbe (2020) established that population-based case-control studies have shown that the rate of children dying in infancy from diarrhea is high in areas without piped water and flush toilets. Water inadequacy may also result in pilling pressure on the available water resources due to overexploitation, thus affecting their sustainability. Therefore, this study focused on conducting a needs assessment of the water sources available for use by non-resident students of the University of Kabianga. The findings will inform the University`s decision-making in line with its plan to enhance accommodation and water provision for students and staff through public-private partnerships as outlined in the University`s 2018-2022 Strategic plan. Moreover, the findings will also inform decision-making at the county level to ensure that private developers adhere to the right housing standards, including providing adequate water supply infrastructure while carrying out developments in Kabianga University town.

1.8 Significance of the Study

This study`s findings will form a basis for providing a sustainable water supply of adequate quality and quantities to non-resident students` hostels at the University of Kabianga. The findings will also inform the stakeholders, such as the private investors in students` accommodation, on appropriate actions that should be implemented to ensure an adequate supply of clean and safe water to their tenants. The findings will further enhance understanding of proper residential development practices and optimal water use through participatory planning with key sector stakeholders such as water service providers and

policymakers, leading to improved people`s access to clean and safe water within Kabianga urban core area as a potential university town.

1.9 Scope and Limitations of the Study

The study area was around Kabianga University town, covering the market centres of Kabianga market centre, Kapmaso market centre, and Chapnyogaa market centre. The study examined existing water supply systems in non-resident students` hostels. The aspects of water supply that were studied included the primary sources, water consumption patterns, and the challenges students face while accessing water.

1.10 Study Assumptions

The study was conducted bearing in mind the following assumptions;

i.   Increased residential development within Kabianga University town continues to put pressure on the existing water supply systems,

ii. University of Kabianga's continued expansion will attract students who will live outside the campus

iii. The private hostels are occupied only by non-resident students of the University of Kabianga.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of the literature on water supply and its associated aspects from the dimensions of areas at global, regional, national, and local scales. Moreover, it also contains the theoretical and conceptual framework of the study, as well as the legal, policy, and institutional frameworks of water supply in Kenya.

2.2 Understanding the Water Supply Situation

Water shortage refers to inadequate water (including those that provide safe drinking water) to meet the demands of a population within a certain region. Therefore, water shortage is population-driven scarcity (Heidari et al., 2021). On the other hand, water stress refers to the impact of high water demand from the available water sources that results in the deterioration of the quality and quantity of the water that is available. Therefore, water stress is demand-driven scarcity that may occur even with a small population without the potential to cause water shortage (Kummu et al., 2016).

Maintaining human health and well-being requires access to clean and safe water for daily usage. However, people`s access to safe and clean water has been challenging in developed and developing countries despite water occupying the largest portion (70%) of the earth. Only 2.5% of the water comprises fresh water. Further, people can only access less than 1% of the freshwater for human usage (Mishra, 2023). Additionally, studies have shown

that approximately 20% of the population lacks access to drinking water, while 40% do not have access to proper sanitation facilities (Davis et al., 2017). Moreover, a larger portion of that population comes from developing nations (Waziri, 2018). This indicates that a significant portion of the global population is not connected to a sustainable water supply system that meets their needs.

Lack of adequate water supply increases the risks of experiencing water-related diseases within a population. This resonates with numerous studies that indicate that nearly 1.1 billion people are subject to a high risk of water-related deaths and diseases due to poor access to clean and safe drinking water, especially in Africa and Asia (Troeger et al., 2018). Approximately 3.5 million annual deaths are caused by water-related diseases. Of these cases, 84% occur among children. Moreover, nearly 90% of deaths are attributed to diarrheal diseases and occur in the developing world's young population (Manetu et al., 2021).

Water stress is driven by many human-related challenges, especially in developing countries like Kenya. Among them is rapid urbanization. Nearly 50% of the world's population resides in urban areas. Further, population projections have indicated that Asian and African countries will have a high urban population in the future, thus increasing pressure on the existing water supply systems (Davis et al., 2017). Proper planning is key to ensuring adequate water supply systems are put in place to meet the demands of the rapidly rising population in urban areas, especially in developing nations like Kenya.

2.3 Access to Safe Drinking Water

The challenge of ensuring that people have sustainable access to drinking water of the required quality and quantity has grown globally over time. However, this situation may differ in specific local contexts. This has been occasioned by the ever-increasing demand for water from human development-related activities such as agriculture, industrialization, and the rapidly increasing human populations that have piled pressure on the limited available water resources. As a result, this has led to a deterioration in the quality and quantity of the available water for human use (Zhang et al., 2020). Further, previous studies have shown that nearly a third of the global population lives in areas experiencing moderate to high water stress. Additionally, approximately 75% of the global population will live in water-stressed regions by 2025 (Barra, 2020). Therefore, the challenge of poor water supply and its resultant effects differ from one region to another, though this problem is most urgent in developing countries.

Developed and developing nations experience water access challenges. Primarily, small communities in both developed and developing countries experience these challenges due to small customer bases. Small customer bases result in inadequate finances for maintenance and operational costs of water supply systems. As a result, the communities experience numerous water-supply-related challenges, such as rationing and poor drinking water standards (McFarlane & Harris, 2018). These challenges force households to adopt measures that may increase the risk of water-related diseases within these communities to ensure a constant water supply. Such measures include water storage, which increases the risks of contamination due to a lack of water treatment or poor storage. Further, these

measures may create breeding places for mosquito vectors that spread malaria, thus leading to poor health among the residents (Van, 2021).

Poor access to safe and clean drinking water has forced people to operate small water systems that are not regulated by the existing laws. As a result, this increases the risk of water contamination, destruction of catchment areas, and deterioration of water sources due to overexploitation (Hansen, 2017). In the United States, people constructed nearly 1000 new small systems annually to increase the water supply in their communities (McFarlane & Harris, 2018). However, some are unregulated under national law, thus increasing the risk of water contamination and deterioration of water sources due to overexploitation.

Lack/or poor access to sustainable sources of clean and safe water has resulted in significant challenges, especially among the vulnerable in society. These problems include poor health, increased household expenses, time wastage, and exhaustion among women. Primarily, this can be attributed to inequalities in society and poor governance and policy-making, thus subjecting people experiencing poverty to the risk of travelling long distances to access water and incurring high costs to meet their water needs (WHO, 2019). In many areas, especially in rural communities, meeting the basic standard of water access is a challenge due to a lack of adequate funding and political will. Ensuring that everyone accesses 20 litres per day of safe drinking from an improved source that is within a 30-minute distance from their premises is achievable by almost every government with more funding (WHO/UNICEF, 2010). Figure 2.1 shows the global water scarcity.
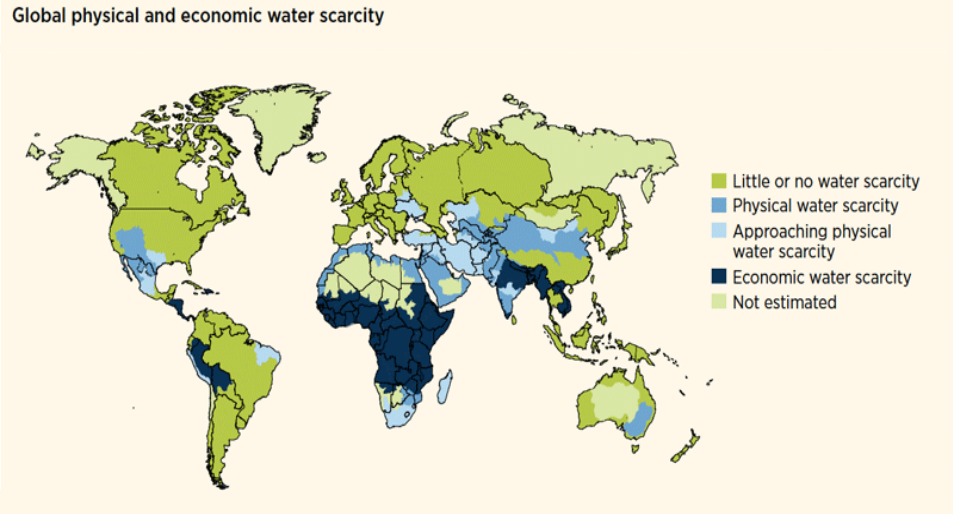
Figure 2.1: *Global water scarcity.*

Source: World Water Development Report 4. World Water Assessment Programme, (2012).

The Kenyan government has implemented measures through the Ministry of Water, Sanitation, and Irrigation to ensure public access to adequate and safe water. Moreover, it has partnered with key stakeholders, including private entities, to ensure people's access to safe water through various initiatives like maintaining Water Purification Points (WPPs) and drilling boreholes (Sambu, 2013). In 2020/21, the government drilled approximately 1,401 boreholes. This number is projected to increase to 4,241 in the year 2021/22, with an expectation that 88.9% of the increase will come from private sector initiatives (Economic Survey, 2022).

The Kenyan government is committed to ensuring adequate water supply by funding various initiatives. These initiatives include water development, staff training, irrigation development, national water harvesting and storage, and rural water supply. According to

the 2022 Economic Survey by the Kenya National Bureau of Statistics, between the 2020/21 financial year and 2021/22, the government`s total expenditure on rural water supply development was projected to increase from Ksh 2.4 Billion to Ksh 3.5 Billion. Additionally, the budgetary allocation for Irrigation Development was increased from Ksh 0.5 Billion to Ksh 1.4 Billion between the 2020/21 financial year and 2021/22, while the allocation of National Irrigation Authority was increased from Ksh 8.5 Billion to Ksh 10.7 Billion (KNBS, 2022). Therefore, this shows the government`s efforts to ensure an adequate water supply to all Kenyans regardless of their status.

Despite the government's measures to ensure adequate water supply, studies have shown a vast difference in water supply coverage between urban areas (71.7%) and rural areas (28.3%). While most urban populations rely on piped water as their primary source, most rural populations depend on streams/or rivers. As a result, the urban population uses more than two times more water than the rural dwellers due to the convenience of accessing their water source (Mutschinski & Coles, 2021).

 The water supply situation in rural areas differs from that of urban areas. All the water service providers in urban areas are regulated by the Water Services Regulation Authority (WASREB). As a result, the water supply coverage is substantial and reliable since the Water Service Providers can meet their operational and maintenance costs. However, the provision of water in informal settlements is challenging due to planning issues and dense unplanned structures. As a result, people rely on water kiosks as their only source of safe water for their uses (Chepyegon & Kamiya, 2018). Conversely, rural dwellers rely on unimproved water sources, thus forcing them to use homemade solutions like boiling to

treat their drinking water. In addition, most rural areas lack piped water systems since their settlements are sparsely populated; thus, investing in such systems is costly (Mulwa & Fangninou, 2021). Furthermore, water projects that have been installed are managed by community groups, whereby a managing committee is tasked with their maintenance. However, delivering their mandate is challenging due to inadequate finance since they only rely on the amount consumers pay for operation and maintenance (Chepyegon & Kamiya, 2018).

 The lack of piped water systems in rural areas has resulted in water shortages, especially in areas where satellite campuses or chartered universities like the University of Kabianga have been established in Kenya. As a result, off-campus students have been forced to rely on water vendors as their water source during the dry seasons and rainwater during the wet seasons (Ogendo et al., 2020). Some landlords have dug shallow wells or boreholes to ensure that off-campus students, as their tenants, have access to water. As a result, students have been forced to use water of unknown qualities, thus subjecting them to the risks of waterborne diseases like typhoid.

2.4 Sources of Water

2.4.1 Surface Water Sources

Surface water results from water accumulation on the ground or in lakes, rivers or oceans. The volume of the accumulated water hinges on several factors. They include watershed size, slope, soil types, land use, and vegetation cover. In most cases, urban water supply systems rely on surface water sources like rivers and lakes due to their capacity to provide

large amounts of water. The advantages of surface water sources include ease of abstracting via pumping and ease of treatment after use. However, their main disadvantage is the need for seasonal treatment before consumption (Katsanou & Karapanagioti, 2017).

Surface water sources obtain their input mainly from precipitation and surface run-off from the catchment areas. On the other hand, their primary output is evaporation, extraction from human activities, and ground and surface water flows. Despite being a significant source for domestic uses, the main challenge of surface water sources is the deterioration of water quality due to human activities such as pollution, fishing, and agriculture (Priyan, 2021).

Most urban areas depend on surface water sources to provide water for their urban population. Surface water sources are preferable since it is easier to draw water through a gravity supply and treat it. The water from these sources is channelled into dams for storage, after which it is treated in various treatment plants for households in urban areas (Ondigo et al., 2018). Such households include off-campus students residing in major cities. On the other hand, the rural population also relies on source water sources, especially rivers, for consumption. However, they rely on homemade solutions for water purification, such as boiling (Cherutich et al., 2015).

2.4.2 Ground Water Sources

Groundwater sources like dug and drilled wells form a significant source of small community supplies due to their low cost of treatment. Other advantages of using groundwater sources like boreholes, shallow wells and springs are the presence of large amounts of groundwater in most inhabited areas and upper soil layers that filter

groundwater against biological, physical and chemical contaminants. In addition, they are reliable during dry seasons and cost-effectiveness since they require less treatment compared to surface water sources (Li et al.,2021). The main recharger of groundwater sources is precipitation, though it may also be recharged through artificial recharge. However, their outlet includes springs, boreholes, and shallow wells. Over-exploitation of groundwater sources by surpassing their "safe yield" has several adverse effects, including land subsidence and deterioration of groundwater quality (Katsanou & Karapanagioti, 2017).

Currently, groundwater sources like boreholes are being used to supplement piped water systems, especially in major urban areas like Nairobi, to meet the demands of the ever-growing urban population. Further, rural towns depend on groundwater sources such as springs to meet their population's demand. In most cases, private water vendors draw the water from the boreholes and then sell it to the residents. However, some households opt to access the springs and draw water to cut costs and ensure high hygiene (Cherutich et al., 2015; Ondigo et al., 2018). This has been the case in many University towns in Kenya that lack a piped water supply system, especially those in rural areas such as Kabianga University town.

2.5 Water Quality

Several factors should be considered while determining the appropriate water source for a particular population. Those factors include adequacy, cost, reliability, quality, legality, and politics (Ricketts et al., 2004). With the increased demand for clean water, people have complemented surface sources, such as streams, rivers, and lakes, with waste-water

recycling and seawater desalination to meet the rapidly growing population (Ricketts et al., 2004). All these initiatives have been focused on ensuring adequate, reliable, affordable, and clean water for consumption.

Certain standards have been outlined to determine the quality of drinking water. Firstly, it should not contain any pathogenic organisms. Secondly, the water should not contain compounds that may pose severe acute human health effects. Moreover, it should have low turbidity, free from salinity. Additionally, the water should not have any smell (Laurent, 2012). Therefore, people must be taught the basic requirements for clean drinking water to ensure healthy communities. Moreover, there is a correlation between the quality of life and the quality and coverage of drinking water. Places with good sanitation and good quality drinking water supply tend to exhibit low or no cases of water-borne epidemics.

Though most developing countries have invested in ensuring adequate water supply in their urban areas, more initiatives should be implemented to ensure that the water is of good quality. According to Opiyo & Otieno (2019), most University towns don't comply with all the housing standards, such as providing adequate water of good quality. As a result, most residents use water sources of unknown qualities, thus subjecting them to the likelihood of getting diseases due to water contamination. Therefore, conducting studies on water use and quality in such University towns, including Kabianga University town, is critical to ensure the well-being of the students and the entire population in those towns.

2.6 Water Consumption patterns

Fresh water scarcity has become a global phenomenon due to climate change, rapid population growth, as well as economic expansion. Pressure on the available water resources is likely to increase significantly according to the projected population growth. A significant amount of pressure comes from domestic and urban users, thus serving as the primary drivers of overexploitation of available freshwater sources. Research shows that this pressure is likely to significantly increase by 2050, especially in Africa, Australia, Asia, and New Zealand (Gerland et al., 2014).

According to the Water Resource Management Authority (2015), Kenya is among the water-scarce countries. Approximately 59% of its population access safe water, though this situation is worse among the urban population (WSRB, 2016). According to Ngetich et al. (2018), for example, the residents of Iten town experience a lower per capita domestic water demand compared to Who`s recommendation of 50 Litres daily since theirs is 44 litres. In addition, their study established that most of the daily usage involved domestic uses, especially laundry. Further, the challenges that people encounter while accessing water determine their daily consumption. Consequently, Koech (2016) established that girls and women go through the most pain due to these challenges, thus exposing them to numerous safety and health risks.

Research has established that social-economic status in Kenya has led to inequality in the distribution and access to safe and clean water sources, especially piped water. As a result, people from low-income neighbourhoods are significantly affected, thus necessitating deliberate governance and planning to promote equity in water distribution. The speed of

18

growth of neighbourhoods also has resulted in this inequality, especially in developing towns like university towns, whose population is significantly determined by the admissions within their neighbouring universities (Mutono et al., 2022).

2.7 Challenges of Water Supply and Sanitation

A country whose annual water availability is below 1700m^3 per capita is categorized as water-stressed. Kenya`s annual per capita water availability is less than 1000m^3, hence its water-stressing nature (Mulwa et al., 2021). As a result, institutions such as the Water Resources Management Authority (WRMA) have recommended implementing critical measures to avert the threat of water scarcity that may significantly affect human lives. Most significantly, the urban slums require the most immediate interventions since they are already experiencing acute water shortages due to the high population (Beard & Mitlin, 2021). This is also the case in many rural towns, such as University towns, due to the high admission rates in Kenyan public and private Universities, as highlighted in the 2022 economic survey. As a result, national and county government institutions like the Physical Planning Departments should ensure that development in urban areas follows the recommended standards to ensure the well-being of every citizen regardless of their social status.

2.7.1 Rapid Urbanization

Most developing nations like Kenya are characterized by rapid urbanization. Africa's urbanization growth rate in the last decade was 3.5% due to high rural-urban migration (Franco et al., 2019). With rapid urbanization and skyrocketing population growth, the

demand for adequate water and sanitation has increased significantly in developing nations. Increased urbanization led to the proliferation of slums and informal settlements in urban areas with no water and sanitation coverage (Beard & Mitlin, 2021).

2.7.2 Water Pollution

Water pollution affects the quality of water due to the entry of various chemical, thermal, and microbiological pollutants, thus rendering it unsafe for drinking. Studies have established that the key contributors to water contamination are industrialization (32.5%) and agriculture 14% despite being the primary stimulators of economic development. Agriculture, for example, introduces fertilizers and agrochemicals into surface water sources through surface runoff. Moreover, industries discharge wastewater with high toxic substance levels in surface water sources, thus increasing the challenge of accessing clean water, especially in urban areas (Mulwa et al., 2021).

Most urban areas depend on both groundwater sources and surface water sources. Though surface water sources are more susceptible to water pollution due to human activities like agriculture and industrialization, the quality of water from groundwater sources may be compromised by various actions like overexploitation of groundwater sources by surpassing their "safe yield" (Ondigo et al., 2018). This has been the case in most University towns in Kenya, especially rural areas where most students rely on surface water sources like rivers and groundwater sources like springs, shallow wells, and boreholes. During the rainy seasons, for instance, the quality of most water sources, like rivers and springs, deteriorates due to an increase in soil particles in water that affect the water`s turbidity. Secondly, surface runoff may add more chemicals to the water, thus adversely

affecting its quality. In addition, most of the towns depend on boreholes, especially during the dry seasons, to complement other sources. As a result, too much water is drawn from them, thus increasing the chances of water quality deterioration, as highlighted by Katsanou &Karapanagioti (2017).

2.7.3 Destruction of Catchment Areas

Water catchment areas support transboundary water bodies by increasing water infiltration in the soil and preventing soil erosion. However, human activities such as deforestation and poor farming practices degrade them, thus leading to increased surface runoff, siltation, reduced infiltration, flash floods, and erosion. Human encroachment, illegal logging, agricultural activities, charcoal burning, and illegal water abstractions by urban industries and settlements have significantly damaged the catchment areas considered "Kenya's water towers," thus increasing water scarcity in urban areas. The "water towers" include Mount Kenya, Cherangani Hills, Mau Forest Complex, Mt. Elgon, and Aberdare Range (Mulwa et al., 2021).

Some university towns in Kenya have piped water systems for their students. As a result, these University towns depend on conserving various water catchment areas for adequate water supply. However, the destruction of significant water catchment areas like Kenya, Cherangani Hills, Aberdare Range, and Mau Forest Complex has necessitated water rationing due to inadequacy of the available water, thus necessitating the use of other water sources like boreholes, especially in dry seasons. As a result, this has led to overexploitation of underground water, thus affecting its quality (Ondigo et al., 2018).

2.8 Impacts of Inadequate Water Supply

Poor access to water and sanitation may result in severe health and socio-economic issues. These effects include increased infant deaths, increased cases of water-borne diseases, reduced productivity and loss of time as people look for water, especially in rural areas. The major categories of the impacts of inadequate water supply are worth examining;

2.8.1 Health Effects

Improving people`s access to water and sanitation is critical in promoting health. Providing a universal piped and regulated global water supply would prevent approximately 7.6 billion annual cases of diarrhea (Forouzanfar et al., 2015). Population-based case-control studies in metropolitan areas globally have shown that children dying in infancy from diarrhea are high in areas without piped water, flush toilets, poorly built houses, and household overcrowding (D'Odorico& Rodriguez-Iturbe, 2020).

Despite the initiatives by many developing countries to improve water, sanitation, and hygiene, the burden of diseases attributed to inadequate access to drinking water continues to be a major challenge. Numerous studies such as Stanaway et al. (2018) that have been conducted over time indicate that most people, especially in rural areas and informal settlements in urban areas, use water of unknown qualities for drinking and other household chores, thus subjecting them to the risk of various water-borne diseases like typhoid, malaria, lymphatic filariasis, lower respiratory infections, trachoma, and protein energy malnutrition. According to Pruss-Ustun et al. (2019), approximately 829,000 deaths in 2016 were connected to water, sanitation, and hygiene issues. For instance, 5.3% (297,000

cases) of deaths among children below five years were caused by diarrhea (Pruss-Ustun et al., 2019).

Data shows that approximately one in four individuals globally lack access to a handwashing facility on their premises. Only 45% of the people reside in areas with coverage of basic sanitation services above 75% (Wolf et al., 2019a; Wolf et al., 2019b). In addition, UNICEF (2017) indicates that approximately 844 million people did not have access to basic drinking water services, such as protected drinking water sources that were accessible within 30 minutes. Moreover, approximately 30% of the population did not have access to convenient drinking water sources that were free from contamination globally. As a result, this forced them to use other water sources of unknown quality for convenience, thus rendering them susceptible to the risks of using contaminated water. In most developing countries like Kenya, most people in rural areas are also forced to rely on water sources of unknown quality for convenience. For example, some people may rely on river water to cut household expenses. Further, those living in rural towns such as Kabianga University towns are also forced to use water from sources of unknown qualities, such as private vendors, thus subjecting them to the risks of using contaminated water. Therefore, it is critical to conduct studies on water use to ensure that residents, such as off-campus students in those towns, have access to adequate water of good quality and quantity.

2.8.2 Socio-economic Impacts

2.8.2.1 Labor Productivity

The absence of sustainable, safe water and sanitation directly impacts the productivity of society. Studies have shown that not only does poor water and sanitation cause deaths, but it also affects people`s health, affecting their economic productivity. For example, the 1991 cholera epidemic in Peru resulted in numerous deaths and nearly $232 million in GDP loss annually. Therefore, realizing Goal 7 of the Sustainable Development Goal (SDG), which champions adequate access to clean water and sanitation globally, requires the eradication of poverty in urban areas. This would guarantee the establishment of formal settlements with quality water supply systems that meet the daily needs of every citizen (WHO, 2012).

A lack of proper WASH facilities results in poor health outcomes within the population. It leads to various water-borne diseases like typhoid and protein-energy malnutrition within communities (Stanaway et al., 2018). As a result, this affects their capacity to deliver on their daily duties, such as reporting at their workplaces to help build the economy. As a result, this limits them from providing for their needs, including those of their families. Moreover, getting sick may limit their capacity to attend classes, thus affecting their academic performance. Therefore, assessing the water supply situation within university towns such as Kabianga University town is critical to ensure that off-campus students access good-quality water.

2.8.2.2 Loss of Time

Studies have shown that people spend more time searching for water, especially in areas characterized by poverty, like rural areas. As a result, less time is spent on economic activities like agriculture and business, thus worsening their financial capacities. According to UNICEF (2017), approximately 844 million people did not have access to basic drinking water services, such as protected drinking water sources that were accessible within 30 minutes. Moreover, approximately 30% of the population did not rely on convenient drinking water sources, free from contamination globally. As a result, this forced them to use other water sources of unknown quality for convenience, thus rendering them susceptible to the risks of using contaminated water.

This shows that people may risk their well-being to access convenient water sources regardless of quality. As indicated, most people opt to use sources that need the minimum amount of time to access to save time for other activities, especially in rural areas. Therefore, having access to good quality water sources and within one's premises, such as piped water, is critical to ensure that people have adequate time for other duties. As a result, it is critical to conduct needs assessment studies on the available water sources for people to ensure they access good-quality water sources.

2.9 Best Practices and Strategies for Sustainable Use of Water

Sustainable water use and management is the responsibility of everyone in the community. As a result, ensuring sustainable and equitable water distribution requires every stakeholder

to be active (Li et al., 2021). Therefore, a number of strategies and principles can be instrumental in ensuring the sustainable use and management of water resources;

2.9.1 Principle 1: Water is a valuable and limited resource, fundamental for development, sustaining life, and the environment

According to this principle, everyone should recognize that water is a finite resource in high demand due to human development-related activities. Among such activities include agriculture, urbanization, and population growth. As a result, water is subjected to immense use and pollution, thus reducing its quality, quantity, and availability. Secondly, people should recognize that the water cycle replenishes available water resources. As a result, it is critical to maintain water catchment areas to ensure constant water supply to the water cycle. On the contrary, the destruction of the cycle through human activities like over-abstraction of water from the water resources, pollution, and destruction of catchment areas will limit the replenishment of the water reserves, thus affecting the water supply (SIWI, 2020). Therefore, people should sustainably manage the water resources and catchment areas through water conservation, recycling water for reusing, harvesting rainwater, and wastewater treatment.

2.9.2 Principle 2: Participatory Approach

The development and management of water resources should involve a participatory approach by actively engaging all stakeholders, including users, policymakers, and planners. Ensuring equitable access to water for all as well as water quality, requires full cooperation, collaboration, and communication from all users. All stakeholders should

engage actively while developing water supply infrastructure. Additionally, a participatory approach in all decision-making processes guarantees accountability and transparency in managing and operating water resources. This approach also ensures that the needs of marginalized individuals, as well as youth, women, and the poor, are considered through the decentralization of decision-making at the community level via the public process of participation (Sambu, 2013).

2.10 Policy, Legal, and Institutional Framework of Water Supply

2.10.1 Water Policy Framework

Several policies and instruments on the water are in place and can be better highlighted;

2.10.1.1 Water Policy and Strategy

According to the Ministry of Water and Sanitation 2018-2022 Strategic Plan, every citizen should have access to safe and adequate water resources and sustainably managed sanitation. The Ministry`s mission is to ensure the protection, conservation and storage, development, and management of water resources for national social-economic development. Pursuant to its vision and mission, the ministry`s strategic goal was to ensure the transition of the national population with access to clean and safe water from 60% (2017) to 80% by 2022. Moreover, the Ministry`s strategic goal was to increase the rural population percentage with improved sanitation access from 52% to 76% and the urban population from 67.5% to 85% (MoWI, 2018).

2.10.1.2 Sustainable Development Goal 6 (SDG 6)

According to the Millennium Development Goals (MDGs) proposal, which transitioned to the Sustainable Development Goals (SDGs), everyone should have access to water. This goal (SDG 6) seeks to ensure adequate and sustainable water access and management for every individual globally (Pereira & Marques, 2021).

2.10.1.3 Kericho County Integrated Development Plan 2018-2022

According to Kericho County`s second-generation County Development Integrated Plan 2018-2022, the county`s vision is to ensure every citizen has access to a high quality of life by providing a sustainable environment. As a result, the county ensures that people access clean water through the Kericho Water and Sanitation Company (KEWASCO), whose mandate is supplying water to the Kericho municipality area and the surrounding peri-urban areas. Moreover, Tililbei Water and Sanitation Company (TILILWASCO) is mandated to supply water to rural areas in the county. The CIDP outlines that though most rural areas draw water mainly from springs and shallow wells, these sources are unsafe, hence the initiative to protect springs through devolved funds like County Government Funds (County Government of Kericho, 2018).

2.10.2 Legal Framework

2.10.2.1 Constitution of Kenya 2010

The Kenyan Constitution (2010) protects every citizen`s right to clean, adequate, and safe water under Article 43(1) (d). Further, it highlights the national government`s responsibilities in meeting this right under the fourth schedule, section 22(c). Such

responsibilities include protecting catchment areas, hydraulic engineering, providing adequate water, and maintaining the dams` safety (GoK, 2010). Further, the county governments are mandated to provide water. Therefore, the national government should provide water resource development while overseeing water service providers` operations at the county level.

2.10.2.2 Water Act 2016

The Water Act (2016) outlines the guidelines and regulations for water resources and sewerage services management and development as provided for in the constitution of Kenya. The Act establishes the Water Resources Authority, the Water Services Regulatory Board, the National Water Harvesting and Storage Authority, the Water Tribunal, and the Water Sector Trust Fund. Under this Act, the Water Resources Authority acts as the national government`s agent in the utilization and management of water resources. Moreover, the authority must develop and enforce water resource use and management regulations, as well as classify water resources. The Water Act also tasks county governments to establish water service providers to ensure access to water for all citizens in the respective counties. This Act also upholds every citizen`s right to safe, clean, adequate water and appropriate sanitation standards (Water Act 2016).

2.10.2.3 EMCA 1999 (Amended 2015)

This Act upholds every person`s right to clean, adequate, and safe water for drinking by providing regulations that prevent the pollution, encroachment, and overexploitation of water resources. Under this Act, everyone is prohibited from causing direct or indirect

water pollution by throwing or discharging liquid, gaseous, or solid substances into water resources. Moreover, it tasks the National Environment Management Authority (NEMA) with monitoring domestic water sources at least twice annually to ensure adequate access to quality water for domestic purposes (EMCA 1999). The Act also demands that Environmental Impact Assessment (EIA) and Audits are done for water supply projects.

2.10.2.4 Lake Basin Development Authority Act

This Act provides for the establishment of the Lake Basin Development Authority (LBDA). Kericho County falls within the LBDA region, and LBDA`s role is to act as a strategic socio-economic development driver and promote regional development sustainably through the use and conservation of the available natural resources in the region via effective coordination, planning, implementation, monitoring as well as evaluation of projects and programs. These projects include water development projects to ensure everyone can access clean and safe drinking water in the region. Secondly, it is the responsibility of the LBDA to direct research studies on resource use to ensure optimal sustainable utilization. For example, it is the Authority`s role to collect and analyze data related to the utilization of water resources in the Lake Basin region to ensure effective planning.

2.10.3 Institutional Framework

The water sector in Kenya has numerous institutions tasked with various duties to ensure adequate access to clean and safe water for all citizens. These bodies include the Ministry of Water and Irrigation (MoWI), the Water Resource Management Authority (WARMA),

the Water Sector Reform Secretariat (WSRS), Water Service Regulatory Boards (WSRBs), the Water Service Boards (WSBs), and Water Service Providers (WSPs). Water Service Boards is responsible for planning the regional upgrade of water supply and sewerage systems and services. Moreover, their task is appointing and contracting water service providers (Rampa, 2011).

The Ministry of Water and Irrigation (MoWI) oversees Kenya's water service sector. Under it are several departments, including Water Resources Management, Land Reclamation and Irrigation, Drainage, Administration and Support Services, and Water Storage. The Ministry also formulates water and sewerage services policies, coordinates and monitors water institutions, and conducts the sector's general investment, planning, and mobilization of resources (Rampa, 2011).

The draft National Water Services Strategy (NWSS) was among the measures the government formulated in 2007 to ensure water availability to all citizens. Its primary purpose was to steer initiatives for achieving adequate, affordable, clean, and safe water, as enshrined in Vision 2030. Moreover, it aimed to recover costs for the water service providers to ensure sustainable and universal water and sanitation, especially in residential areas for low-income areas like informal settlements (MoWI, 2005).

The Water Services Regulatory Board (WASREB) is responsible for licensing and supervising Water Service Boards, developing and negotiating tariff guidelines, and setting and developing service provision guidelines (MoWI, 2005).

2.10.3.1 Role of the Non-Governmental Organizations and Civil Organizations

A participatory approach to the management of water resources requires input from all stakeholders, including civil rights organizations, non-governmental organizations, community-based organizations, as well as individual activists. It's the mandate of the Kenya Water and Sanitation Civil Society Network (KEWASNET) to ensure adequate water service delivery, especially in areas with low-income people. It is also mandated that water policies be properly implemented in the water services reforms. KEWASNET is also meant to carry out campaigns to protect water services provision infrastructure from vandalism by appealing to community members to responsibly use and consume available water and sanitation services. (KEWASNET, 2012). Additionally, non-governmental organizations are responsible for championing people`s right to access clean water through activism.

2.10.3.2 Community-Based organizations

Community-based organizations organization such as Informal Small Service Providers (SSPs) play a key role in ensuring an adequate, accessible, affordable, safe, and clean water supply in small communities, especially among rural settlements and low-income settlements in urban areas. In most cases, these organizations are run by women in most areas. However, they must submit proposals like Community Project Cycle to formalize their services (MoWI, 2005). Figure 2.2 shows the institutional framework of water resource management in Kenya.
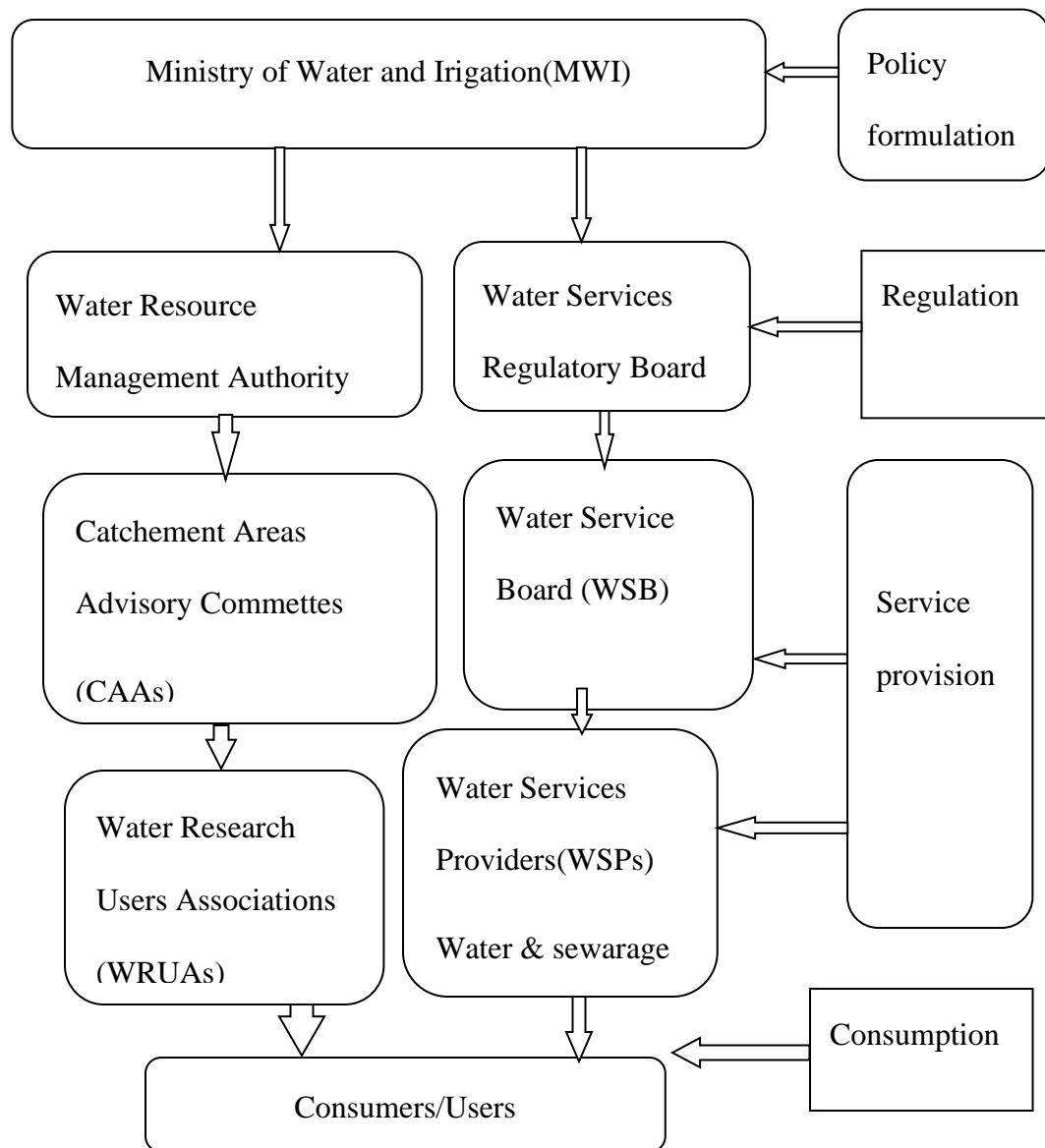
Figure 2.2: *Institutional Framework of water resource management in Kenya.*

Source: Adapted from Mulwa & Fangninou, 2021.

2.11 Theoretical Framework

Sustainable provision of reliable, safe, affordable, accessible, and sufficient water for all calls for joint coordination of all the stakeholders. However, the absence of formal utility structures for the management of water resources, especially in rural areas, leads to the adoption of informal water resource management methods, especially for shared water points, thus creating distinct organizational challenges. However, these challenges can be managed through the adoption of cultural theory, which offers a framework that elaborates on how various world views can be unified to offer different solutions to such challenges (Cleaver & De Kining, 2015). According to the Cultural theory, there are four cultures that, to a large extent, resonate with water "management cultures," especially in rural areas- community, bureaucratic, individualist, and fatalism (Sharp et al., 2015).

2.11.1 Community

According to the community culture of water point management, informal groups adopt risk-sharing approaches in the management of water resources. In the case of water scarcity, such groups opt for water rationing, while the high repair costs are shared among all community members (Foster, 2013). In addition, committees are appointed for the collective operation, maintenance, repair, and management of the water points. The communities are tasked with regular activities like holding meetings, determining, collecting, and saving users' financial contributions, as well as formulating and enforcing access and use regulations (Moriarty et al., 2013).

2.11.2 Individualistic

This culture embraces an "individualist ownership approach" whereby the water points are privately managed through self-regulation. Moreover, the owner exercises their sovereignty in the management of the water point, including selling water and taking full risks like the high cost of maintenance. As a result, their prices keep on fluctuating depending on the market forces of supply and demand (Sutton & Harvey, 2017).

2.11.3 Bureaucratic

This culture embraces institutional sovereignty in the management of water points since only the concerned institutions have the authority to make decisions regarding the water points. As a result, the institutions avoid operational, financial, and environmental uncertainties/challenges through regulations and procedures. In most cases, the institutions are governed by schools or religious institutions. Moreover, they obtain state funding for maintenance undertakings, including water service infrastructure (Cleaver & De Kining, 2015).

2.11.4 Fatalist

This culture may be "stoic" and "opportunist" behavior in water resource management. As a result, the community members leave the management of the water point to fate since they ascribe very minimal benefit to any efforts of managing the resource. However, this approach is mainly contributed to by societal vices like misappropriation of funding, which leads to a loss of trust among community members. This leads to the reliance on the

external actor for rehabilitation of the resources, thus forcing marginalized groups like women and children to serve as water collectors and thus embracing a no-cost alternative. Secondly, fatalism may result from active choice whereby society members adopt opportunistic behavior. As a result, they wait for fate to determine all outcomes as they wait for other actors, such as non-governmental organizations and the government, to help in dealing with their challenge (Hollway & Enrico, 2012)

Based on the four cultures highlighted by the Cultural theory, a pluralist approach incorporating the coexistence of four ideal-type cultures is the best for water resource use and management. This approach advocates for creatively integrating all cultures` perspectives to identify challenges and develop effective solutions despite their insistence on their points of view. Their cooperation could allow all cultures to operate effectively in the management of water resources within the three core pillars of bureaucracy, market, and community through sustainable financing, improved flow of information, and reliable maintenance (Ney &Verweij, 2015). Additionally, the market forces are allowed to determine water prices based on the law of supply and demand. Figure 2.3 highlights the interaction of various elements of a pluralist approach to water resources management.
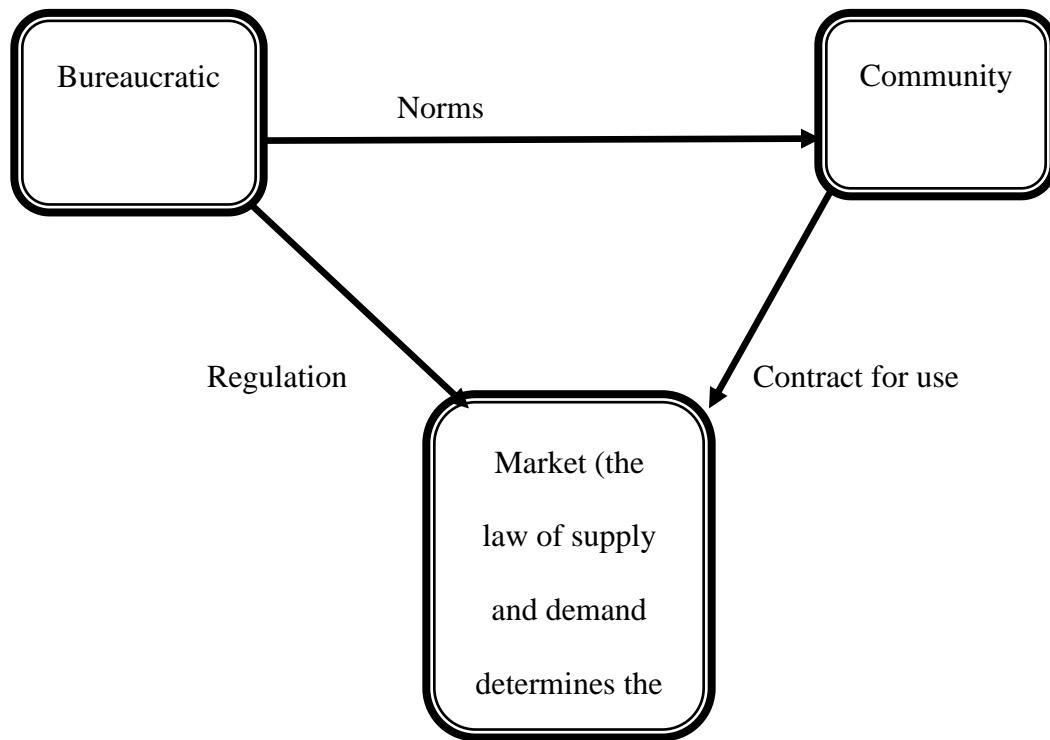
Figure 2.3: *Cultural Theory.*

2.12 Conceptual Framework

Figure 2.4 below illustrates this study's independent, intervening, and dependent variables. The independent variable to be assessed was the available water sources and uses. The available water sources should be reliable, affordable, and accessible to ensure the wellbeing of the non-resident students of the University of Kabianga (Romano, 2014). Further, assessing this variable was critical in providing insight into the challenges of accessing water.

The study's dependent variable was the quality of life for the non-resident students of the University of Kabianga. According to Teoli & Bhardwaj (2020), Quality of life (QoL) encompasses an individual`s or population`s well-being in relation to the positive and negative aspects of their existence within a particular period in its entirety. Further, the facets of Quality of Life include personal health (mental, physical, and spiritual), wealth, education status, relationships, social status, security and safety, autonomy, especially in decision-making, freedom, physical surroundings, and social identity (Teoli & Bhardwaj, 2020). The available water sources should meet the needs of the current non-resident students and future populations to ensure a good quality of life.

The available water sources should be accessible, reliable, and affordable to allow students to participate in their curricular and extra-curricular activities maximumly. In addition, they should be reliable in ensuring their physical and mental health and promoting effective time management. Water source accessibility entails how fast a student can access it in the minimum time possible and at an affordable price. On the other hand, water source reliability involves consistently supplying water to the students without failure or reduction

in the required amounts. Assessing this variable was critical in determining the perceived implications of the challenges of accessing water on the quality of life for the non-resident students of the University of Kabianga. Therefore, determining the water sources' availability, reliability, and accessibility was essential in determining whether interventions are necessary to ensure the desired quality of life for the non-resident students of the University of Kabianga.

The intervening variables for this study were policy formulation and implementation, catchment protection, and county government initiatives. Participation in catchment protection by various stakeholders is critical to ensuring a consistent water supply from various sources. Additionally, the county government should play a key role in water policy formulation and implementation to ensure conservation and protection of the water sources as well as ensuring everyone in the town has access to clean and safe water.
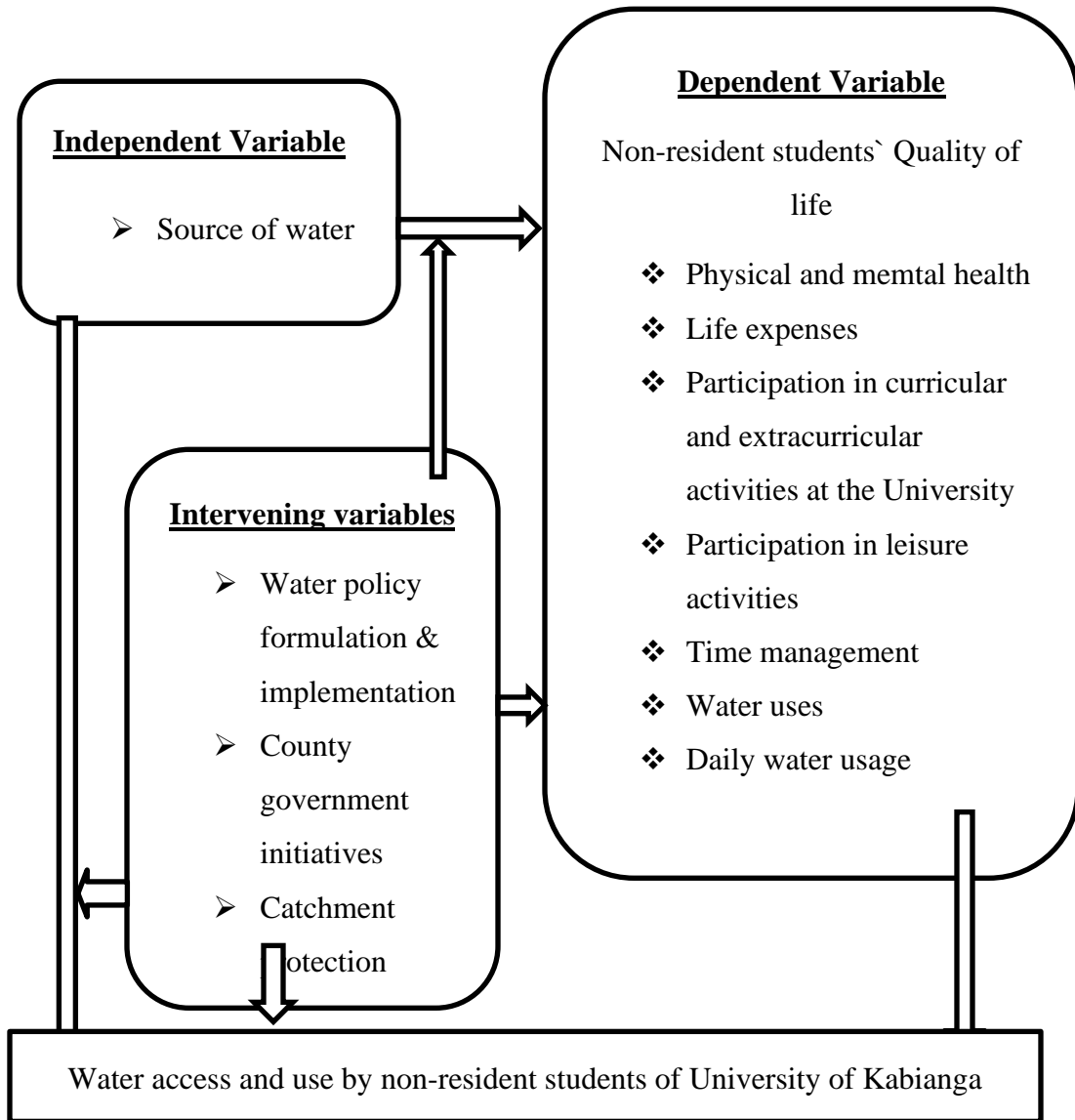
Figure 2.4: *Conceptual Framework*

2.13 Identification of Knowledge Gap

The sustainability of water supply within major cities and towns hosting universities has

been the central focus of most global studies. Most have focused on water distribution,

while others have focused on clean water supply. However, few studies have focused on

small towns in most developing countries, especially university/college towns where non-resident students from those institutions reside. Regardless, most of them have focused on a holistic view of off-campus students' challenges in private hostels. However, despite most studies identifying the water supply challenge in Kenyan cities and Africa, none has focused explicitly on assessing water supply within private hostels in university towns in Kenya to determine how private hostels can access adequate water. Most importantly, little or no studies on water supply for non-resident students of the University of Kabianga have been conducted yet, hence the need for this study. Therefore, this study will provide vital information that will inform stakeholders and policymakers on critical issues that can be addressed to ensure sustainable water supply within University towns in Kenya and beyond.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the research methodology that entails the research design, study area, target population, sampling procedures, study instruments, data collection procedure, data analysis, and presentation.

3.2 Research Design

The study used a descriptive survey design because it effectively described the current phenomenon without manipulating variables. A descriptive survey design explores a phenomenon in detail without manipulating it. Akhtar further observes that descriptive survey design effectively gathers information, summarizes, presents, and interprets data in preliminary and explorative studies (Akhtar, 2016).

3.3 Study Area

The study was conducted at the University of Kabianga township. The township was conferred as a town since an integrated plan was done in 2015 and approved in 2018. Moreover, it had a population of 17,000 residents per the census of 2009 and had sufficient space for expansion.

Table 3.1:

UoK Township Population by Sex and Sub-Location, 2009

Division	Location	Sub-location	Sex		Total	Area in Km^2	Households	Density
			Male	Female				
		Kibingei	795	809	**1,604**	4.4	338	364.61
Kabianga	Kabianga	Kapcheluch	2,691	2,872	**5,563**	11.37	1,119	489.19
Kabianga	Mobego	Kabianga	3,338	2,922	**6,260**	13.06	1,297	479.17
		Mobego	2,255	2,316	**4,571**	11.46	882	398.86
		Overall total	**9,079**	**8,919**	**17,998**	**40.29**	**3,636**	**446.71**

Source: Kenya National Bureau of Statistics (2010): 2009 Kenya Population and Housing Census, Volume I A

Figure 3.1. below is the map of the study area.
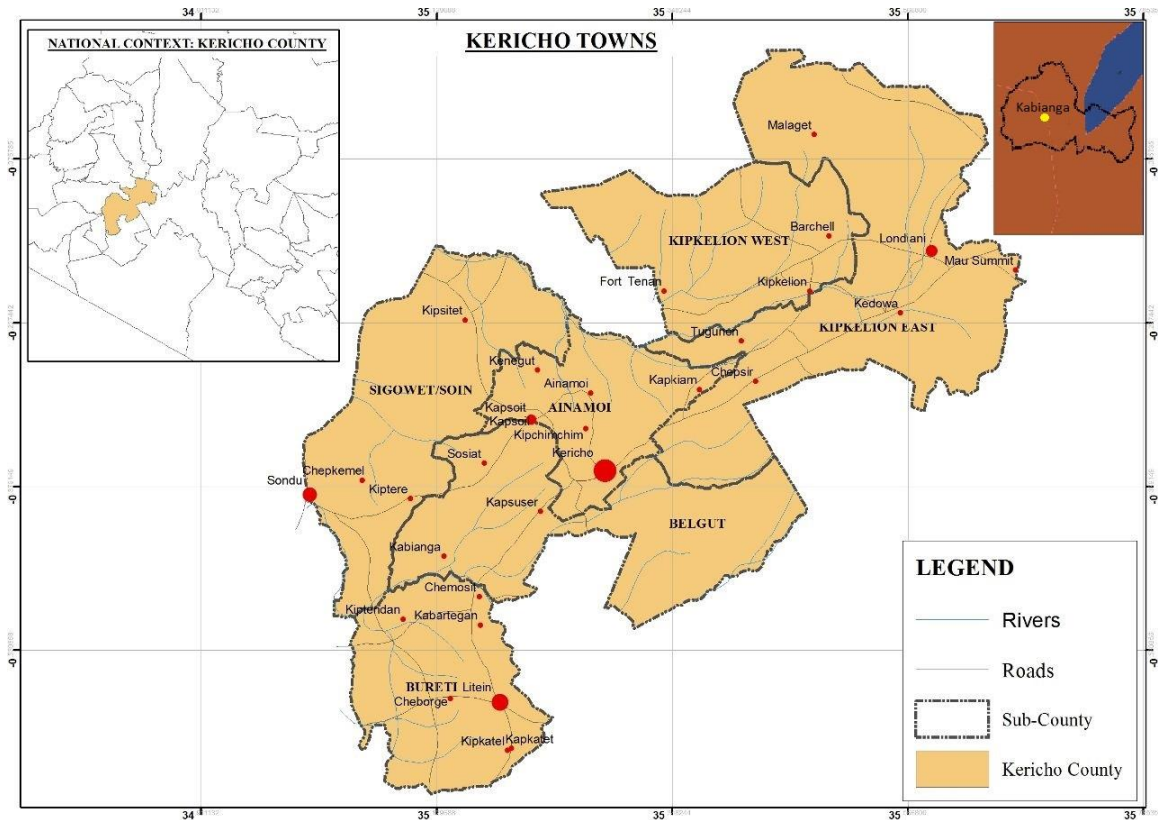
Figure 3.1: *Location of Kabianga University Town.*

3.4 Target Population

The target population for this study was non-resident students residing in private hostels off-campus. Being a public university town, it would provide a good representation of public university students' experience in private hostels. The main reason for preferring this area was the increase in students residing in private student accommodation hostels and the increased construction of low-standard private hostels within the town.

The target population included all the non-resident students residing within the Kabianga market center, Kapmaso market center, and Chepnyogaa market center. However, the population did not encompass other residents who were not students from the University

of Kabianga. Therefore, non-resident students of the University of Kabianga residing outside the boundaries of Kabianga University town were not part of the study. Hence, this population consists of individuals with the characteristics of the people suitable for the study, thus providing the scope of the population suitable for determining the sample size.

Table 3.2:

Student stay status from 2018/19 to 2021/22

Academic Year	Resident Students	Non-Resident Students	Total
2018/19	899	506	1405
2019/20	915	554	1469
2020/21	1569	424	1993
2021/22	1577	673	2250

Source: Uok, 2023

3.5 Sample and Sampling Procedures.

Oribhabor and Anyanwu (2019) assert that a sample from a large population can be calculated using the formula below;

$n = N/[1+N(e)^2]$

$= 673 \div \{1+[673(0.05)^2]\}$

$= 250.89$

≈ 251

Where

n = the sample size

N = total population (673)

e = tolerance of desired confidence level (0.05%) at 95% confidence level

Hence, the sample size is 251 students.

Table 3.3:

Distribution of the target population

Location	No. of Students
Kapmaso	106
Chepnyogaa	29
Kabianga	116
Total	250

Simple random sampling was used to categorize students into various subgroups (gender, year of study, and centres where they stayed). In addition, simple random sampling was used to select the students to ensure that all the students had an equal and known chance of inclusion in the study.

Random sampling was used to select private student accommodation hostels (15 Hostels from 50 hostels). The researcher selected hostels that contained a large population of students, unlike those that were mostly populated by individuals who were not students.

3.6 Data Collection Instruments

This study used four research instruments: questionnaires, key informant interviews, an observation guide, and photography.

i.   **Questionnaire for Students**

Questionnaires were preferred for data collection from the non-resident students because they are appropriate in descriptive surveys with many respondents. Moreover, the questionnaires allowed the respondents to express their views and make suggestions freely.

ii.   **Key informant interviews**

The researcher used interviews to gather information from the key informants, such as Hostel Department Officers at the University, NEMA, physical planners, Word administrators, and landlords for the private hostels. Interviews are more effective than questionnaires when collecting information from a small sample since one can gather more data from respondents because the questionnaires tend to limit more data. Therefore, this was critical in collecting data on the available water sources within the hostels.

iii.   **Observation Schedule**

Observation guides were used to collect information on the various water supply sources within private student accommodation hostels. While using them, the researcher was

supposed to tick the water sources available within the selected hostels. Therefore, this tool was useful in collecting relevant data for the first and second objectives by providing data on the available water sources and various water uses within the hostels.

iv.   Photography

Photograpy was used to collect data on the state of the various water sources.

3.6.1 Validity of Instruments

The researcher assessed content validity using a test and re-test experiment to determine their internal consistency using a baseline scale of 0-1. Having obtained a Cronbach's alpha score of 0.7, the instruments (Key informant interview guide and questionnaires) were considered valid. In addition, professionals, including my university supervisors and other senior lecturers within the department, evaluated the instruments to determine their content validity through a three-point scale (not necessary, useful, but not essential and essential). Additionally, five panelists conducted the study's content validity.

3.6.2 Reliability of the Research Instrument

The reliability of the questionnaires and key informant guides was assessed using a pilot study, after which a score was established. According to Taherdoost (2016), the reliability of a pilot study should be equal to or above 0.60. Other suggested cut-off points for reliability include excellent reliability (≥ 0.90), high reliability (between 0.70 and 0.90), moderate reliability (between 0.50 and 0.70), and low reliability (≤ 0.50) (Taherdoost, 2016). The questionnaires and key informant interviews were administered to Chuka University non-resident students and key informants twice within one month. Afterward, a

correlation coefficient between the two assessments` scores was calculated. The instruments were deemed reliable after obtaining a Pearson correlation coefficient of 0.653, which was found to be valid.

3.7 Data collection procedures

The data for the first objective was collected using an observation guide (Checklist) whereby the researchers ticked the available water sources for further analysis. Moreover, the respondents were required to highlight the available water sources within their hostel while completing the questionnaires. The landlords also outlined the sources they provided for their tenants during the interviews.

The data for the second objective was collected using questionnaires whereby the respondents were required to highlight their uses of water as well as the amount of water they consume daily. In addition, the questionnaires were used to collect data on the third objective, whereby every respondent was required to outline how the challenges of accessing water impacted their quality of life.

3.8 Data Analysis and Presentation

1) Objective one: To establish the water sources available for non-resident students of the University of Kabianga

   Descriptive statistics, such as percentages, were used to analyze the available water sources for various seasons and other factors associated with the sources, such as average daily water usage, preferred water sources during the wet and dry seasons, and types of available water sources.

2) Objective two: To determine water consumption patterns amongst the non-resident students of the University of Kabianga.

   The researcher used measures of central tendency, such as means, to determine the average daily water usage among the students.

3) Objective three: To determine the challenges of accessing water among non-resident students of the University of Kabianga.

   The researcher used descriptive statistics like percentages to determine the water access challenges such as the time used for accessing the water sources, water prices, distance from the hostels to the water sources, and the reliability of water in terms of its safety for all their uses.

The collected data from the field was coded and entered into the computer for analysis using Statistical Package for Social Sciences (SPSS). Thematic analysis was used to analyze qualitative data. Descriptive statistics, including percentages and frequency counts, were used to analyze the quantitative data. Finally, the output was presented with graphs, charts, and tables.

3.9 Ethical Considerations

The researcher obtained permission to conduct research from the National Commission for Science, Technology, and Innovation (NACOSTI). Informed consent was sought from the landlords to conduct the study in the hostels. Moreover, the researcher communicated the study`s objective to the respondents and guaranteed anonymity and confidentiality. The NACOSTI permit is shown in the appendix. In addition, the researcher sought the approval of the Board of Graduate Studies, University of Kabianga, to conduct this study.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter gives a detailed presentation of research findings according to objectives. The study`s specific objectives were to establish the sources of water available for non-resident students of the University of Kabianga, determine the water consumption patterns among the non-resident students of the University of Kabianga, and determine the challenges for accessing water among non-resident students of the University of Kabianga.

4.2 Background Information on Respondents

4.2.1 Gender of Respondents

According to the findings, 53% of the respondents were males, while 47% were females (N=250). The percentage of male non-resident students was higher mainly due to male students' desire for privacy, as shown in Figure 4.1
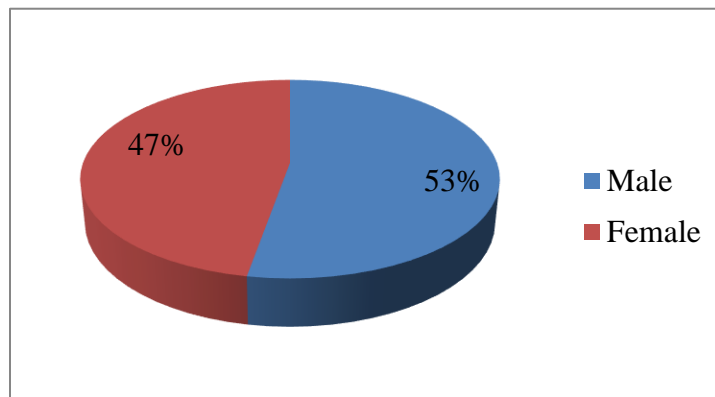
Figure 4.1: *Gender of the respondents.*

4.2.2 Average Number of Students in a Housing Unit

Most of the housing units (75%) comprised one student. This was due to the respondents' desire for privacy, although others claimed that the campus hostels had strict rules that limited their freedom. However, those who lived together as two students (22%) or more than two individuals (3%) gave reasons like cost sharing to manage the high household expenses like rent. Figure 4.2. shows the distribution of the number of students per housing unit.
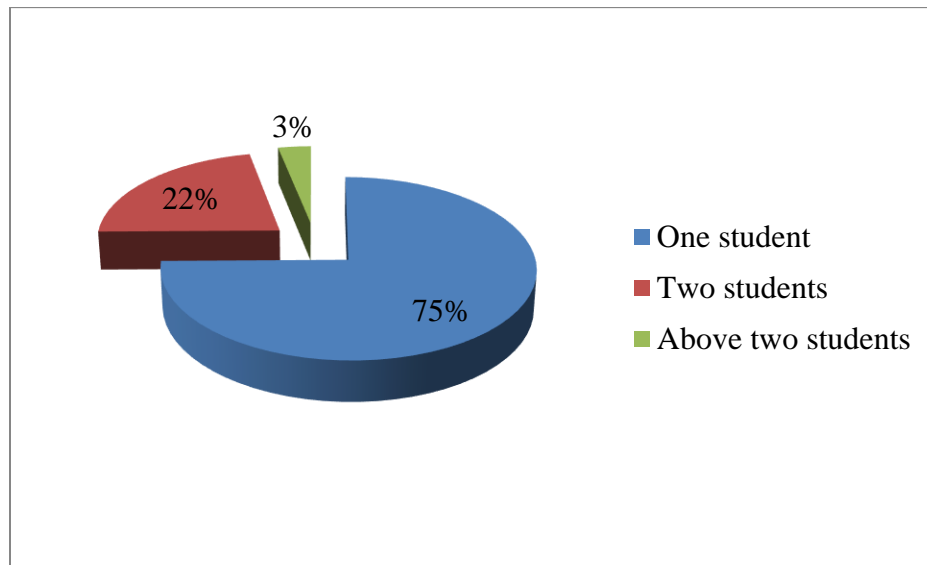
Figure 4.2: *Number of students in a housing unit.*

4.3: Sources of Water Available for Use by Non-resident Students

The first objective of this study was to establish the sources of water available for non-resident students of the University of Kabianga. Determining primary water sources would shed light on the accessibility, reliability, and suitability of water for the various uses of the students.

According to the findings, the majority of the respondents (68%) relied on rainwater harvesting during the rainy season, 20 % of the respondents relied on wells/boreholes, and 9% relied on water vendors. The smallest percentage (3%) of the respondents obtained their water from community water projects such as the Kapmaso water project, as depicted in Figure 4.3
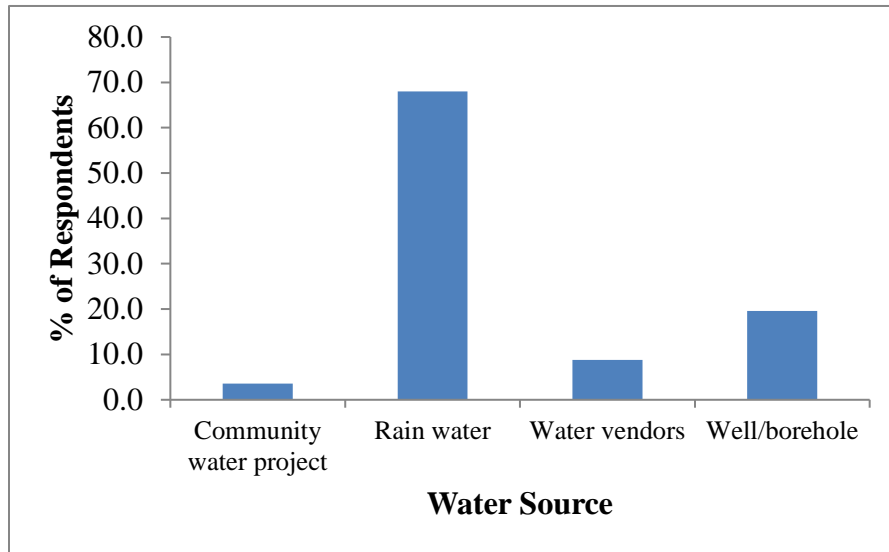
Figure 4.3: *Primary sources of water during the rainy season.*

On the usage of water during the dry season, it was noted that most of the respondents (45.6%) obtained water from wells/boreholes, while 44% of the respondents obtained water from water vendors, as indicated in Figure.4.4
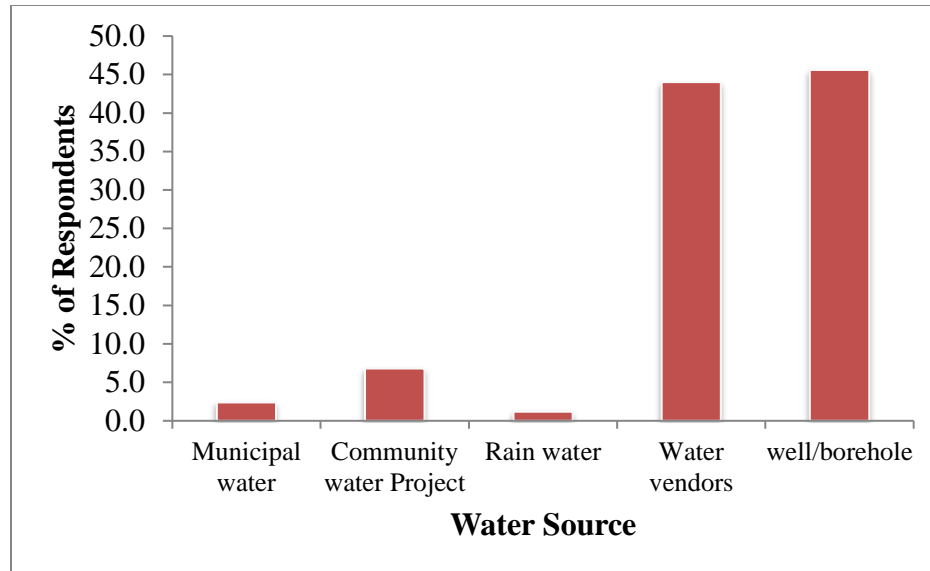
Figure 4.4: *Main source of water during the dry season.*

According to the majority of the respondents (61%), the available sources of water were not safe for drinking. Some argued that water from the wells was untreated. Others claimed that the water vendors` level of hygiene was poor since their water vessels were rarely washed, thus increasing the chances of their water being contaminated. In addition, others whose residential houses had rainwater harvesting water tanks confirmed that their landlords never made any efforts to ensure the water tanks were cleaned regularly.
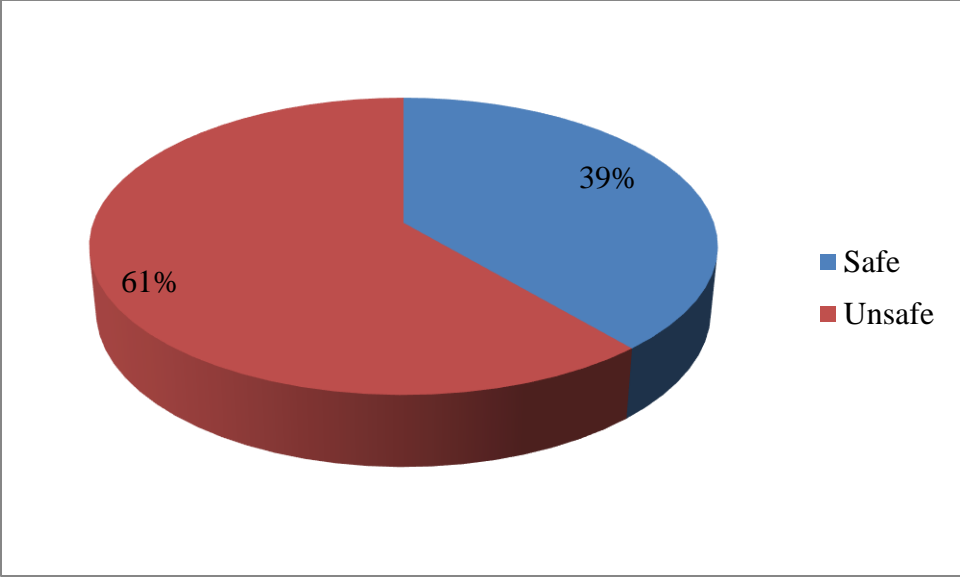
Figure 4.5: *Perceptions for Drinking Water Safety.*

An assessment was done on students' satisfaction on County Government`s role in water supply in the town and the results showed that   majority (93%) of the students were unsatisfied with the Kericho County government`s role in ensuring that the town`s residents had reliable, affordable, and sustainable water sources as shown in Figures 4.6. and 4.7 respectively.
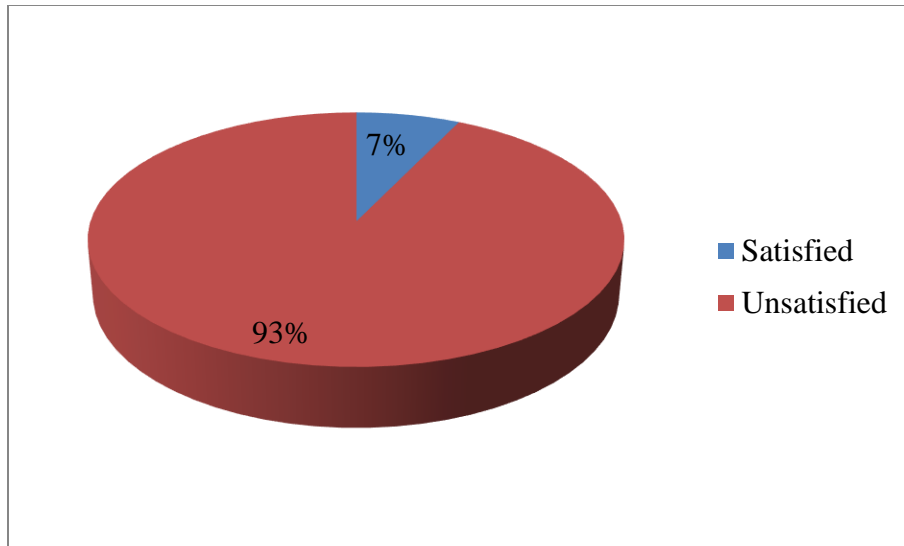
Figure 4.6: *Student satisfaction with the County Government`s role in water supply in the town.*
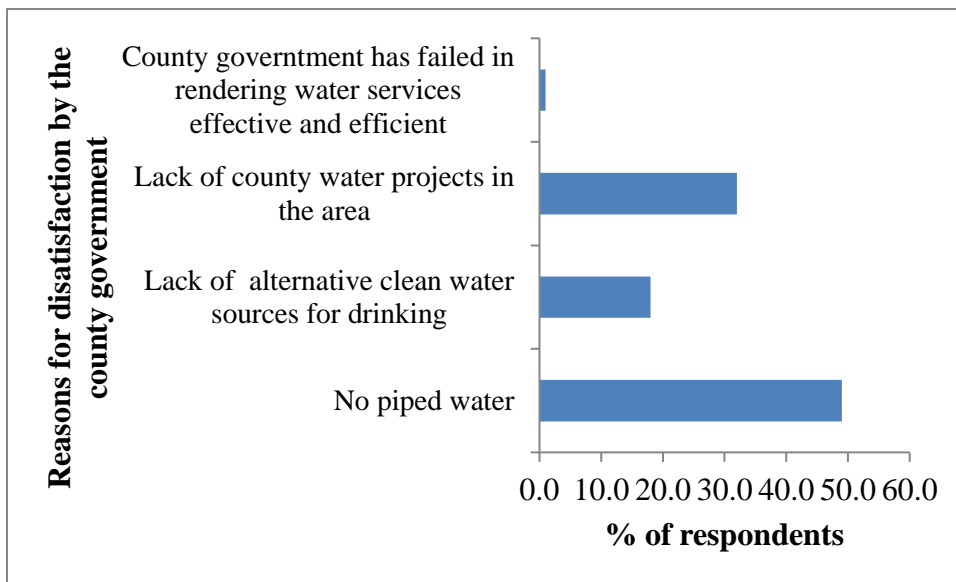
Figure 4.7: *Student satisfaction with the County Government`s role in water supply in the town.*

According to most (49.4%) of them, the town lacks a piped water supply system for distributing water to their respective hostels, thus leaving them to pay high costs for water of unknown quality from water vendors. Moreover, (17.7%) claimed that the county did not provide alternative sources of clean water, like clean water tankers, from which their landlords could buy water for their daily uses. Their claims were confirmed by landlords and the University`s hostels department. For example, one of the landlords claimed that "there was no existing clean water supply distribution system from which they could access water for their tenants, thus necessitating the provision of other sources of unknown quality like shallow wells and rainwater harvesting." Moreover, officers from the hostel's department confirmed that some hostels did not have reliable water sources within their premises for use by the tenants who were non-residents of the University.

According to a study by Wagner et al. (2020), using the available water source doesn't necessarily mean that the residents don't have any regard/value for clean drinking water. Instead, point-of-use treatment such as filtering, boiling, or chlorinating may be more cost-effective than paying a higher price or walking long distances to access clean water. Moreover, it may also minimize the risks of re-contamination during water transport. Therefore, the respondents' use of the available water, regardless of its quality, didn't necessarily mean that they disregarded the importance of clean drinking water but found it cost-effective.

4.4 Water Consumption Patterns

The second objective was to assess water consumption patterns among non-resident students of the University of Kabianga, and Table 4.2 presents the results.

Table 4.1:

Per Capita water consumption

Gender of respondents	Mean	Std. Deviation	Median	N
Male	35.0379	21.10042	30.0000	132
Female	47.4153	13.08638	50.0000	118
Total	40.8800	18.78930	40.0000	250

According to the study, male respondents' per capita water consumption was 35.0379 litres per person (capita) per day (sd=21.21745), while females' per capita water consumption was 47.4153 litres per person (capita) per day (sd= 13.09656). However, the average daily per capita water consumption was 40.9756 litres per person (capita) per day (sd= 18.87292). Therefore, this shows that females' average daily water demand is 47.54 litres per person (capita) per day, which is higher by 12.4277 litres per person (capita) per day than men's. This difference was mainly attributed to the variation in water usage between male and female students. For example, female students used more water while doing their laundry and other house chores compared to male students. Regardless, the per capita household water consumption is 40.9756 litres per person (capita) per day, indicating water inadequacy since one should use an average amount of 50L per day (WHO, 2013).

World Health Organization (2013) recommends that a person uses approximately an average daily water consumption of 50Litres of water to ensure that most of their essential

needs and health concerns are met. Moreover, one should use an average of approximately 30 litres daily for personal hygiene. Consequently, any amount below this measure may be attributed to an inadequate water supply that forces them to minimize the amount of water they use for their hygiene (WHO, 2013). According to the study, the per capita household water consumption is 40.9756lpcd (sd= 18.87292), thus indicating water inadequacy since one should use an average amount of 50L per day. Therefore, this shows that the available water sources provided inadequate water, hence the numerous challenges and the need for reliable alternative water sources.

4.5: Challenges for accessing water among non-resident students of the University of Kabianga

The third objective of this study was to determine the challenges that non-resident students of the University of Kabianga face while accessing available water sources, and the results indicated that the changes in weather patterns were mentioned as the main cause of the challenge in accessing water. This was mainly due to the scarcity of water during the dry seasons, which led to high water demand and, hence, high water prices. Moreover, high rainfall resulted in an increase in soil particles in water, thus compromising the quality of water in such areas as water colour and turbidity from private vendors. In addition, during the rainy seasons, the roads to the springs were impassible due to lack of murram or tarmac, thus limiting the water supply, especially within hostels with inadequate water harvesting facilities. Figure 4.8 shows the main causes of challenges of accessing water, while plates 4.1 and 4.2 depict water transport using animals.
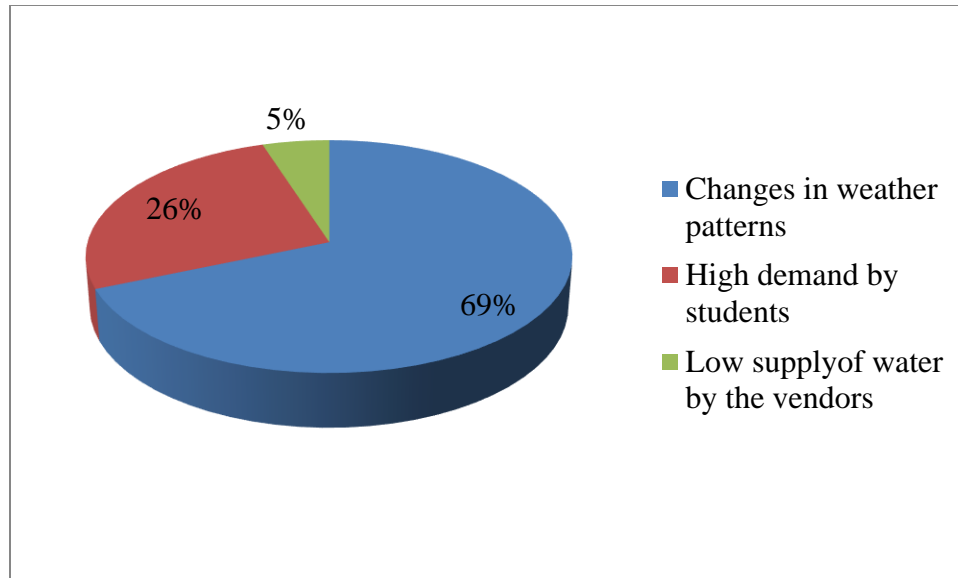
Figure 4.8: *Contributors towards the main challenges of accessing water.*

Plate 4.1: *A Donkey transporting water from the well.*

Plate 4.2: *The hilly terrain from the well.*

Very few respondents (5%) considered a low water supply by water vendors as a major cause of the challenges in accessing water in the study area, especially during the rainy seasons. Additionally, 26% of the respondents cited high water demand as a challenge in accessing water, especially during the dry seasons, as indicated in Figure 4.8.

According to most respondents (78%), water scarcity, especially during the dry seasons, led to time wastage. Apart from waiting for water vendors for long periods due to demand, some were forced to walk for more than one kilometre to access the water points, thus leading to time wastage (approximately 30-60 minutes daily). Secondly, 16% of the respondents reported concerns regarding the likelihood of contamination of waterborne diseases due to poor hygiene among water vendors who formed a significant water source, especially in the dry season. In addition, 6% of the respondents considered exhaustion as a key challenge in accessing water, primarily due to walking for long to access the water sources such as springs, which were a major source of water for the water vendors. Figure

4.9 provides a summary of challenges for accessing water among non-resident students of the University of Kabianga.
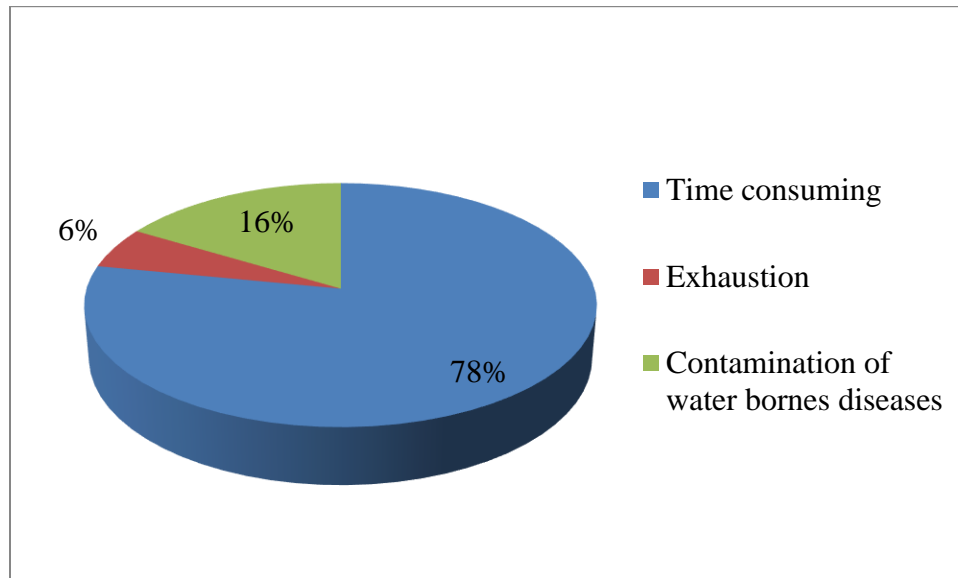
Figure 4.9: *Challenges for accessing water among non-resident students of the University of Kabianga.*

Correlational analysis was done on the relationship between the cost of 20L jerrican of water and the time needed to access the water sources, and the correlation result showed that there is a positive and statistically significant Pearson product correlation (r= 0.516, p<0.01). This indicates that an increase in the time used to access water results in a rise in the cost of water. This explains the fluctuation in water prices, especially during the dry seasons. Table 4.2 shows correlational analysis.

Table 4.2:

The relationship between the cost of 20L jerrican of water and the time needed to access the water sources.

		Time for accessing water	Cost of 20L Jerican of water
Time for accessing water	Pearson Correlation	1	.516**
	Sig. (2-tailed)		.000
	N	249	172
Cost of 20L Jerican of water	Pearson Correlation	.516**	1
	Sig. (2-tailed)	.000	
	N	172	173

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

4.5.1: Implications of the challenges that non-resident students of the University of Kabianga face while accessing water on their quality of life.

According to the findings, most respondents (77%) indicated that the cost of water was very high during the dry season, with prices of a 20Litre Jerrican of water -selling between 15-25 Kenya shillings, thus rendering it unaffordable. These prices keep on fluctuating depending on water scarcity and student demand. As a result, students are forced to follow

the water vendors to the spring to ensure they do not spend a lot of time waiting to buy water because the demand is very high, especially during January and February; thus, the highest bidders were bound to get it first. Additionally, the high water prices force some students to walk to the spring, where they can fetch water. However, this results in exhaustion, thus affecting their commitment to their studies. Therefore, the high prices increase their living expenses and limit their commitments to studies due to exhaustion and time wastage while trying to access the water sources. Figure 4.10 presents the results on the affordability of available water sources to students.
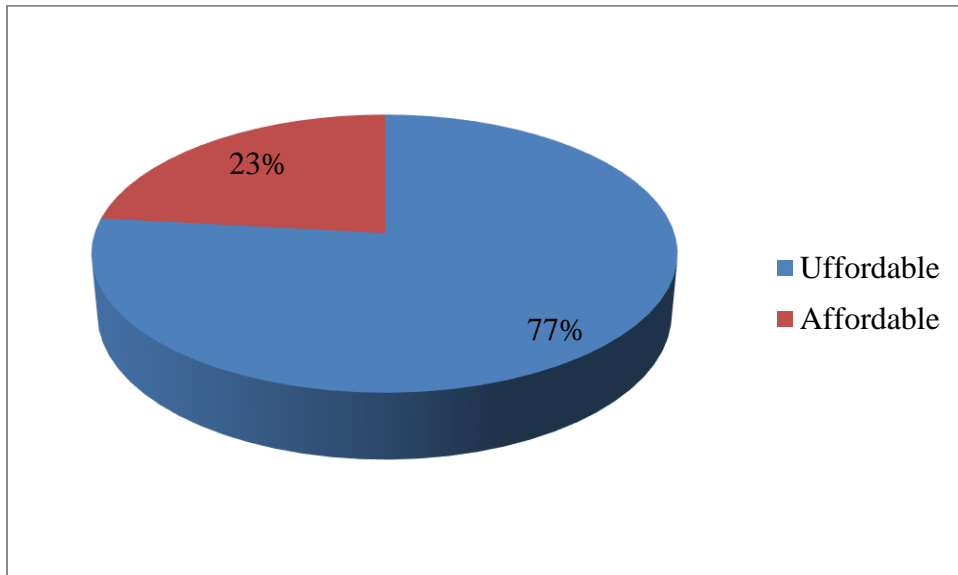
Figure 4.10: *Affordability of available water sources for students.*

Secondly, female respondents reported suffering the most during the dry seasons -where most female non-resident students are forced to pay high prices for water or wait for their male counterparts to get water first since walking for more than one kilometer to the spring was dangerous, exhausting, and tiresome. According to one of the respondents, "it is

challenging to access water during the dry seasons since the male students have to get water first because they follow the water vendors to the springs-an exercise that is exhausting to most of the female students." According to another, "accessing water during the dry seasons is expensive because one has to be the highest bidder to be given priority by the water vendors." Therefore, this shows that these water sources are unreliable, especially in the dry season, since the respondents were forced to pay high costs to get water or walk for more than a kilometer to fetch water or book a vendor from whom they would be assured of buying from. Either way, they wasted a lot of time that could be used in conducting their curricular activities, hence their assertion that the available water sources were unreliable.

Analysis was done on preferred source of water based on reliability and accessibility during the dry seasons, and the findings showed that most (58%) preferred piped water as the most reliable for them, 26% of the respondents preferred rainwater, while 16% preferred shallow wells or boreholes as shown in Figure 4.11.
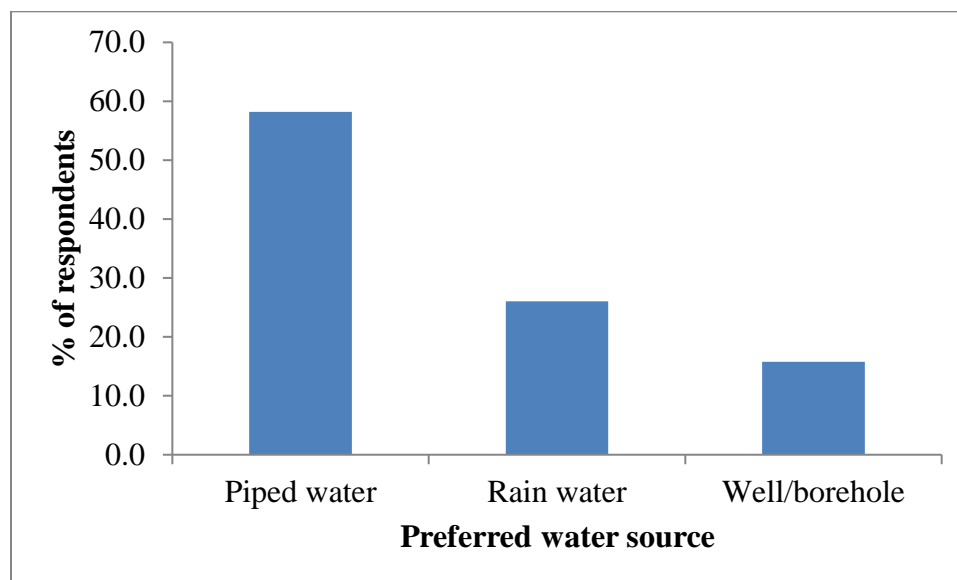
Figure 4.11: *Preferred source of water based on reliability and accessibility during the dry seasons.*

Student preference for the primary water source was based on its suitability for drinking, its effect on their studies in terms of the time they spent accessing its water, its availability, and reliability during the dry and wet seasons, as well as cost. The findings further indicated respondents` preference for the most reliable and accessible water source was its effect on their studies in terms of the time they spent accessing it.

Haque et al. (2015) established that an increase in temperature significantly impacted water consumption. This agrees with this study`s finding that weather forms a significant challenge in accessing water since a temperature rise during the dry seasons will increase the water demand, thus creating a shortage. Additionally, Romano et al. (2014) state that rainfall strongly influences residential water consumption. This resonates with this study`s findings since rainfall increases the water supply during the rainy seasons, thus reducing the demand. However, it also poses various risks, such as an increase in soil particles in water, thus affecting its color and turbidity. Moreover, increased rainfall renders the access roads to the wells impassible, thus limiting the water vendors from supplying the students with adequate water.

According to Njora & Yılmaz (2021), the challenges associated with accessing water affect people`s quality of life. For example, while households with a reliable water source like piped water incur less water costs, those who depend on unreliable water sources walk for long distances beyond a kilometer to access water. Moreover, households are subjected to fluctuating prices by water vendors, unlike state-owned companies that provide clean

water. In addition, the water vendors determine the water prices depending on their perceptions of their clients` economic status. According to Teoli & Bhardwaj (2020), Quality of life (QoL) encompasses an individual`s or population`s well-being concerning the positive and negative aspects of their existence within a particular period in its entirety. Further, they cite several facets of Quality of Life that are common, such as personal health (whether mental, physical, or spiritual), wealth, education status, relationships, social status, security and safety, autonomy, especially in decision-making, freedom, physical surroundings and social-identity (Teoli & Bhardwaj, 2020). According to this, the challenges that the students encounter while accessing water affect their freedom, education, life expenses, and personal health, both mental and physical.

The findings show that the students are forced to incur high costs that fluctuate based on demand to pay for the available water in the dry seasons. As a result, their daily expenditure increases as prices increase. The students also waste valuable time that could have otherwise been used to do their curricular activities while walking for more than a kilometer to access water sources. In addition, the exhaustion that student experience due to walking for long distances affects their comfort. For this reason, these challenges affect the student's physical health and mental health due to fatigue and exhaustion. Further, they also affect their studies due to time wastage while accessing water. Therefore, the challenges of accessing water experienced by the non-resident students of the University of Kabianga adversely affect their quality of life by subjecting them to exhaustion, increased daily expenses due to high prices of buying water as well as infringing on the time available for their studies through time wastage while accessing the water sources.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides an overall summary, draws conclusions, and makes recommendations based on research findings. Moreover, it also outlines areas for further research agenda.

5.2 Summary of Findings

The study's main goal was to assess the sources of water used by non-resident students of the University of Kabianga and their perceived implications on the student's quality of life within Kabianga University town, Kenya. It was carried out using a sample size of 251 students, of whom 53% were males while 47% were females. Moreover, most students (75%) lived alone in their houses, whereas 25% shared rooms. The single occupation of rooms by students was attributed to the respondents' desire for privacy, with others claiming that the campus hostels had strict rules that curtailed their freedom.

5.2.1 Water sources available for use by non-resident students of the University of Kabianga

It was established that most respondents (68%) relied on rainwater harvesting during the rainy season, while a relatively smaller percentage (3%) of the respondents obtained their water from community water projects. Most respondents draw their water from wells/boreholes (45.6%) and vendors (44%) during the dry seasons. It was further

established that students' preference for the primary source of water during dry and wet seasons was based on the source's suitability for drinking, its effect on their studies in terms of the time they spent accessing water, its availability and reliability during the dry and wet seasons, and cost element

5.2.2: Water consumption patterns

According to the study, the per capita household water consumption is 40.9756 litres per person (capita) per day (sd= 18.87292). Further, male respondents' per capita water consumption was 35.0379 litres per person (capita) per day (sd=21.21745), while females' per capita water consumption was 47.4153 litres per person (capita) per day (sd= 13.09656).

5.2.3 Challenges for accessing water among non-resident students of the University of Kabianga

Most respondents cited the seasonal changes in weather patterns as the main contributor to the challenges in accessing water, while others indicated high water demand as a challenge in accessing water (26%) and low water supply by water vendors (5%), especially during the dry seasons. Students considered the cost of water as very high during the dry season since 20 litres of water were sold at between 15-20 shillings. Moreover, these prices fluctuated depending on water scarcity and student demand. Other challenges that were linked with water scarcity during the dry season include walking for more than a kilometer to access water, exhaustion, and time wastage while waiting for private vendors to buy water. Additionally, female students were mostly affected during water-scarce periods

since they were forced to pay high prices for water or wait for their male counterparts to get water first. In addition, walking for more than one kilometer to the spring was exhausting and challenging for them.

5.3 Conclusions

This study sought to establish water sources available for non-resident students of the University of Kabianga, water consumption patterns among non-resident students of the University of Kabianga, and the challenges that non-resident students of the University of Kabianga face while accessing the water sources.

5.3.1: Water Sources Available for Non-resident Students of the University of Kabianga

According to the study, rainwater harvesting is the main water source during the rainy season. However, the students rely on other sources, including private water vendors and community water projects. On the other hand, wells/boreholes and vendors are the main water sources for the non-resident students during the dry seasons.

5.3.2: Water Consumption Patterns

According to the study, the per capita household water consumption is 40.9756lpcd (sd= 18.87292), thus indicating water inadequacy since one should use an average amount of 50L per day according to World Health Organization recommendations. This shows that the available water sources provided inadequate water, hence the numerous challenges and the need for additional reliable alternative water sources.

5.3.3: Challenges for accessing water among non-resident students of the University of Kabianga

The weather changes are the key contributors to water access challenges. Further, water scarcity during the dry seasons leads to increased water demand, hence the fluctuation of water prices that are already high for the students. Additionally, the challenges of accessing water experienced by the non-resident students of the University of Kabianga adversely affect their quality of life by subjecting them to exhaustion, increasing daily expenses due to high prices of buying water as well and infringing on the time available for their studies through time wastage while accessing the water sources.

5.4 Recommendations

According to the findings, students experience serious water shortages, especially during the dry seasons. Moreover, water prices keep on fluctuating depending on the season and demand for water. Additionally, most students' preference for the most convenient water source is based on the source's suitability for drinking, its effect on their studies in terms of the time they spend accessing its water, its availability and reliability during the dry and wet seasons, and cost. Therefore, the study makes the following recommendations;

1. The landlords should work together with water resource development and management agencies to provide a more reliable water source, like piped water, from which students can get water at their convenience.

2. The University of Kabainga should allow non-resident students to tap into the water for drinking and cooking to ensure their health and safety to

protect them against the likelihood of infections and, therefore, disruption of learning, leading to delays in the completion of programmes.

3. The Ministry of Health, through the Public Health Department, should carry out inspections on water storage and vessels and, more specifically, ensure that landlords maintain high standards of hygiene by cleaning storage tanks. The operations of water vendors should also be regulated. Moreover, the harvested water should be treated for the health and safety of the students to prevent diseases like typhoid.

5.5 Suggestions for Future Research

1. It was established that most students consider their water sources unsafe for drinking, thus requiring further research on the analysis of water quality from the sources they rely on.

2. Further study should be done on whether water access by off-campus students affects academic performance in terms of grades and completion rate.

3. Another study should be conducted on water demand for resident students at the University of Kabianga for a comparative analysis of this study.

REFERENCES

Akhtar, D. M. I. (2016). Research design. *Research Design (February 1, 2016).*

Anang, Z., Padli, J., Rashid, N. K. A., Alipiah, R. M., & Musa, H. (2019). Factors affecting water demand: macro evidence in Malaysia. *Jurnal Ekonomi Malaysia*, *53*(1), 17-25.

Barra, R. O. (2020). The 2019 Global Environment Outlook and Global Chemicals Outlook: challenges for environmental toxicology and chemistry in Latin America. *Current Opinion in Green and Sustainable Chemistry*, *25*, 100352.

Beard, V. A., &Mitlin, D. (2021). Water access in global South cities: The challenges of intermittency and affordability. *World Development*, *147*, 105625.

Chepkener, J. J. (2018). *Factors influencing undergraduate students' level of satisfaction with on-and off-campus accommodation at Moi university main campus, Kenya* (Doctoral dissertation, Moi University).

Chepyegon, C., & Kamiya, D. (2018). Challenges faced by the Kenya water sector management in improving water supply coverage. *Journal of Water Resource and Protection*, *10*(1), 85-105.

Cherunya, P. C., Janezic, C., &Leuchner, M. (2015). Sustainable supply of safe drinking water for underserved households in Kenya: investigating the viability of decentralized solutions. *Water*, *7*(10), 5437-5457.

Cherutich, J., Maitho, T., & Omware, Q. (2015). Water access and sustainable rural livelihoods: A c ase of Elementaita Division in Nakuru County, Kenya.

County Government of Kericho. (2018). Second-generation County Development Integrated Plan 2018-2022. https://repository.kippra.or.ke/bitstream/handle/123456789/1068/2018-2022%20Kericho%20County%20CIDP.pdf?sequence=1&isAllowed=y

D'Odorico, P., & Rodriguez-Iturbe, I. (2020). Sustaining water resources. In *Health of People, Health of Planet and Our Responsibility* (pp. 149-163). Springer, Cham.

Dagnew, D. C. (2012). *Factors determining residential water demand in north western Ethiopia, the case of Merawi* (Doctoral dissertation, Cornell University).

Davis, K. F., Rulli, M. C., Garrassino, F., Chiarelli, D., Seveso, A., &D'Odorico, P. (2017). Water limits to closing yield gaps. *Advances in water resources*, *99*, 67-75.

Forouzanfar, M. H., Alexander, L., Anderson, H. R., Bachman, V. F., Biryukov, S., Brauer, M., & Murray, C. J. (2015). King's Research Portal. *Lancet*, *386*(10010), 2287-2323.

Foster, T. (2013). Predictors of sustainability for community-managed handpumps in sub-Saharan Africa: evidence from Liberia, Sierra Leone, and Uganda. *Environmental science & technology*, *47*(21), 12037-12046.

Franco, I. B., Chatterji, T., Derbyshire, E., & Tracey, J. (2019). *Actioning the global goals for local impact*. Springer: Berlin, Germany.

Gerland, P. Raftery, A., Sevcikova, H. (2014). World stabilization unlikely this century. Science. 346(6206), 234-237.

Gleick, P. H., & Cooley, H. (2021). Freshwater Scarcity. *Annual Review of Environment and Resources*, *46*.

Government of Kenya, (2010). *The Constitution of Kenya*.Nairobi: Government printers.

Government of Kenya. (1999). The Environment Management and Coordination Act 1999. Government printers.

Government of Kenya. (2016). The Water Act 2016. Government printers.

Goyol, K. B., &Girma, A. A. One WASH National Program (OWNP) Ethiopia: A SWAp with a comprehensive management structure.

Hansen, K. (2017). Meeting the challenge of water scarcity in the Western United States. In *Competition for water resources* (pp. 2-18). Elsevier.

Haque, M. M., Egodawatta, P., Rahman, A., &Goonetilleke, A. (2015). Assessing the significance of climate and community factors on urban water demand. *International Journal of Sustainable Built Environment*, *4*(2), 222-230.

Heidari, H., Arabi, M., Warziniack, T., & Sharvelle, S. (2021). Effects of urban development patterns on municipal water shortage. *Frontiers in Water*, *3*, 694817.

Hollway, J., & Enrico, C. P. (2012, May). Finding fatalism, or, how to take cynics seriously. In *Department of Anthropology, University College London. Paper Presented at the 3rd Annual Mary Douglas Seminar* (Vol. 18).

Hollway, J., & Enrico, C. P. (2012, May). Finding fatalism, or, how to take cynics seriously. In *Department of Anthropology, University College London. Paper Presented at the 3rd Annual Mary Douglas Seminar* (Vol. 18).

Katsanou, K., &Karapanagioti, H. K. (2017). Surface water and groundwater sources for drinking water. *Applications of Advanced Oxidation Processes (AOPs) in Drinking Water Treatment*, 1-19.

Kenya Bureau of Statistics. (2022). *Economic Survey.* Nairobi.

Kericho County Government. (2018). *Second Generation County Development Integrated Plan 2018-2022*. Kericho County.

KEWASNET, (2012), *Kenya's water and sanitation statistics*: http://www.endwaterpoverty.org/sites/endwaterpoverty.org/files/Kenya Killer Stats Poster .Kummu, M., Guillaume, J. H., de Moel, H., Eisner, S., Flörke, M., Porkka, M., ... & Ward, P. J. (2016). The world's road to water scarcity: shortage and stress in the 20th century and pathways towards sustainability. *Scientific reports*, *6*(1), 38495.

Koech, J. C. (2016). Analysis of household water demand, distribution and community management strategies in Nyangores sub catchment, Bomet County, Kenya. *Unpublished thesis submitted to Kenyatta University*.

Kummu, M., Guillaume, J. H., de Moel, H., Eisner, S., Flörke, M., Porkka, M., ... & Ward, P. J. (2016). The world's road to water scarcity: shortage and stress in the 20th century and pathways towards sustainability. *Scientific reports*, *6*(1), 1-16.

Laurent, A et al (2012). Improving Water Supply Systems for Domestic Uses in Urban Togo: The Case of a Suburb in Lomé. Water 2012, 4, 123-134

Li, P., Karunanidhi, D., Subramani, T., & Srinivasamoorthy, K. (2021). Sources and consequences of groundwater contamination. *Archives of environmental contamination and toxicology*, *80*, 1-10.

Manetu, W. M., M'masi, S., &Recha, C. W. (2021). Diarrhea Disease among Children under 5 Years of Age: A Global Systematic Review. *Open Journal of Epidemiology*, *11*(3), 207-221.

McFarlane, K., & Harris, L. M. (2018). Small systems, big challenges: Review of small drinking water system governance. *Environmental Reviews*, *26*(4), 378-395.

Ministry of water and irrigation, (2005). Design manual for water supply in Kenya: Nairobi. Government printer.

Ministry of Water and Sanitation. (2018). *Strategic Plan 2018-2022*.

Mishra, R. K. (2023). Fresh water availability and its global challenge. *British Journal of Multidisciplinary and Advanced Studies*, *4*(3), 1-78.

Moriarty, P., Smits, S., Butterworth, J., &Franceys, R. (2013). Trends in rural water supply: Towards a service delivery approach. *Water alternatives*, *6*(3), 329.

Mulwa, F., Li, Z., & Fangninou, F. F. (2021). Water scarcity in Kenya: current status, challenges and future solutions. *Open Access Library Journal*, *8*(1), 1-15.

Mutono, N., Wright, J., Mutembei, H., & Thumbi, S. M. (2022). Spatio-temporal patterns of domestic water distribution, consumption and sufficiency: Neighbourhood inequalities in Nairobi, Kenya. *Habitat International*, *119*, 102476.

Mutschinski, K., & Coles, N. A. (2021). The African Water Vision 2025: its influence on water governance in the development of Africa's water sector, with an emphasis on rural communities in Kenya: a review. *Water policy*, *23*(4), 838-861.

Ngetich, M. J., Kiplagat, A. K., & Ng'etich, J. (2018). An Investigation into Domestic Water Consumption Patterns in Iten Town, Kenya. *Africa Environmental Review Journal*, *3*(1), pp-200.

Ngochi, B. M. (2020). *Impacts of University Location on Rural Neighborhood Land Use a Case of Kenya Methodist University Main Campus in Meru County* (Doctoral dissertation, University of Nairobi).

Njora, B., & Yılmaz, H. (2021). Evaluation of water accessibility, distribution, water use policies and management in Kenya. *International Journal of Water Management and Diplomacy*, *1*(3), 5-16.

Ogendo, M., Mbatia, W., Mwende, R., & Mutiria, B. (2020). Challenges of off-campus living for non-resident students in kenya medical training college. *African Journal of Education and Practice*, *6*(4), 64-83.

Ondigo, D. A., Kebwaro, J., & Kavoo, A. M. (2018). Water resources and management under increasing urban demography: A Kenyan perspective—A review.

Ondigo, D. A., Kebwaro, J., &Kavoo, A. M. (2018). Water resources and management under increasing urban demography: A Kenyan perspective—A review.

Oribhabor, C. B., & Anyanwu, C. A. (2019). Research Sampling and Sample Size Determination: A practical Application. *Journal of Educational Research (Fudjer)*, *2*(1), 47-57.

Pereira, M. A., & Marques, R. C. (2021). Sustainable water and sanitation for all: are we there yet?.*Water Research*, *207*, 117765.

Priyan, K. (2021). Issues and challenges of groundwater and surface water management in semi-arid regions. *Groundwater resources development and planning in the semi-arid region*, 1-17.

Rampa, F. (2011). Analysing governance in the water sector in Kenya. *European centre for development and policy management Discussion Paper*, (124).

Ravichandran, M et al (2012).Ethics and Sustainability: *A review of Water Policy and Management*.American Journal of Applied Sciences 9 (1): 24-31, 2012.

Ricketts, J. T., Loftin, M. K., & Merritt, F. S. (2004). *Standard handbook for civil engineers*. McGraw-Hill Education.

Romano, G., Salvati, N., & Guerrini, A. (2014). Estimating the determinants of residential water demand in Italy. *Water*, *6*(10), 2929-2945.

Sambu, D. K., & Tarhule, A. (2013). Institutional water reforms in Kenya: an analytical review. *Water Policy*, *15*(5), 777-793.

Sharp, L., Macrorie, R., & Turner, A. (2015). Resource efficiency and the imagined public: Insights from cultural theory. *Global Environmental Change*, *34*, 196-206.

Stanaway, J. D., Afshin, A., Gakidou, E., Lim, S. S., Abate, D., Abate, K. H., ... & Bleyer, A. (2018). Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet*, *392*(10159), 1923-1994.

Stockholm International Water Institute. (2020). Manual 1: Principles and practices of integrated water resources management. https://siwi.org/wp-content/uploads/2020/06/IWRM_Manual1_final.pdf

Sutton, S., & Harvey, P. (2017). Making universal access to water affordable in Zambia and Zimbabwe.

Taherdoost, H. (2016). Sampling methods in research methodology; how to choose a sampling technique for research. *How to Choose a Sampling Technique for Research (April 10, 2016).*

Taherdoost, H. (2016). Validity and reliability of the research instrument; how to test the validation of a questionnaire/survey in a research. *How to test the validation of a questionnaire/survey in a research (August 10, 2016).*

Teoli, D., & Bhardwaj, A. (2020). Definition/Introduction. *Patient Self-Determination Act.*

Troeger, C., Blacker, B. F., Khalil, I. A., Rao, P. C., Cao, S., Zimsen, S. R., ... & Reiner, R. C. (2018). Estimates of the global, regional, and national morbidity, mortality, and aetiologies of diarrhoea in 195 countries: a systematic analysis for the Global Burden of Disease Study 2016. *The Lancet Infectious Diseases*, *18*(11), 1211-1228.

Unicef. (2017). Progress on drinking water, sanitation and hygiene.

United States Agency for International Development. (2021). Kenya water resources profile overview. *The winrock Organization.* https://winrock.org/wp-content/uploads/2021/08/Kenya_Country_Profile-Final.pdf

Van Vliet, M. T., Jones, E. R., Flörke, M., Franssen, W. H., Hanasaki, N., Wada, Y., & Yearsley, J. R. (2021). Global water scarcity, including surface water quality and expansions of clean water technologies. *Environmental Research Letters*, *16*(2), 024020.

Wagner, J., Cook, J., &Kimuyu, P. (2019). Household demand for water in rural Kenya. *Environmental and Resource Economics*, *74*(4), 1563-1584.

Water Services Regulatory Board (WASREB) (2016).Impact: A Performance Review of Kenya's Water Services Sector 2014-2015.Nairobi: WASREB

Water Resources Management Authority (WRMA) (2015). Strengthening Regulations for Sustainable Water Resources Management in Kenya. Nairobi: WRMA

Waziri, S. I., Nor, N. M., Hook, L. S., & Hassan, A. (2018). Access to safe drinking water, good sanitation, occurrence of under-five mortality and standard of living in developing countries: System GMM approach. *J. Ekon. Malaysia*, *52*(2), 1-13.

WHO/UNICEF (2008*). Progress on Drinking-water and Sanitation, special focus on sanitation.* New York/Geneva, United Nations Children's Fund and World Health Organization.

WHO/UNICEF (2010). *Progress on Sanitation and Drinking-water, 2010 update.* Report of the WHO/UNICEF Joint Monitoring Programme. Geneva/New York, World Health Organization/United Nations Children's Fund.

Wolf, J., Johnston, R., Freeman, M. C., Ram, P. K., Slaymaker, T., Laurenz, E., & Prüss-Ustün, A. (2019). Handwashing with soap after potential faecal contact: global, regional and country estimates. *International journal of epidemiology*, *48*(4), 1204-1218.

Wolf, J., Johnston, R., Hunter, P. R., Gordon, B., Medlicott, K., & Prüss-Ustün, A. (2019). A Faecal Contamination Index for interpreting heterogeneous diarrhoea impacts of water, sanitation and hygiene interventions and overall, regional and country estimates of community sanitation coverage with a focus on low-and middle-income countries. *International journal of hygiene and environmental health*, *222*(2), 270-282.

World Health Organization (2013). How much water is needed in emergencies. Technical Notes on Drinking-water, Sanitation and Hygiene in Emergencies (9) 1-4.

World Health Organization, (2012). *Rapid assessment of drinking-water quality*: a handbook for implementation. Geneva. WHO Press.

World Health Organization, (2012). UN-water global annual assessment of sanitation and drinking water (GLAAS) 2012 report: the challenge of extending and sustaining services. Geneva. WHO Press.

World Health Organization. (2019). *Progress on household drinking water, sanitation and hygiene 2000-2017: special focus on inequalities*. World Health Organization.Zhang, D., Sial, M. S., Ahmad, N., Filipe, A. J., Thu, P. A., Zia-Ud-Din, M., & Caleiro, A. B. (2020). Water scarcity and sustainability in an emerging economy: a management perspective for future. *Sustainability*, *13*(1), 144.

APPENDIX I: Questionnaire for the respondents.

The purpose of this questionnaire is to collect data on water use sustainability and management by non-resident students of UoK. Moreover, the information collected will be confidential and specifically used for the aforementioned purpose only. Thank you.

SECTION A: DEMOGRAPHIC DATA (tick where applicable)

    1. Gender:

   i.   Male

  ii.   Female

SECTION B:

    2. What is your household's main water source?

Source	Dry season	Wet season
Municipal water supply system		
Community water project		
Rainwater harvesting		
Private water vendors		
Private well/borehole		

3. Is the source of water reliable (can it be accessed at any time according to one`s convenience)?

   i. Yes

   ii. No

4. Which of the following water sources would be the most convenient for you?

   i. Rainwater

   ii. Piped water,

   iii. Private water vendors,

   iv. Private well/borehole

   v. Others(specify)

5. What is the daily household water usage (in litres/day)?

6. What are the major uses of water in your household?

7. Does your source of water affect the amount of water you use daily? **Yes** or **No.**

   Explain_____

   _____

   _____

   _____

8. Do you prefer your source of water to be suitable for all your household uses?

i. Yes

ii. No

9. If **No,** explain

_____

_____

10. How long does it take to access clean water from your water source?

i. 1-10 minutes

ii. 10-20minutes

iii. 20 and above

11. Does the duration taken to get water from the source affect its accessibility and reliability?

12. How do you pay for water?

i. Per 20 litre jerrican

ii. Per month

iii. Both

13. If it`s per 20 litre Jerican, how much does one Jerican cost?

    i. 10

    ii. 15

    iii. 20

    iv. 30

14. How do you rate your monthly water cost?

i. Affordable

ii. Unaffordable

iii. Not applicable

15. Is there a time of the year when accessing your main source of water becomes challenging?

16. What is the main cause of the challenge in accessing the water during such a period?

  i.   Weather

 ii.   High demand for water by the students

iii.   Low supply of water by the private water vendors

17. Do you regard your water source as one of good quality for drinking?

  i.   Yes

 ii.   No

18. If **No,** which source of water would you prefer as of good water quality?

  i.   Piped water

 ii.   Rainwater

iii.   Well/borehole

19. Do you think the available source of what negatively affects your studies? Explain_____

_____

_____

_____

20. Are you satisfied with the County Government's role in providing water services within this town?

  i.   Yes

 ii.   No

Explain_____

_____

_____

_____

APPENDIX II: Checklist of the available water sources

Water sources	Available (yes/no)	Functional (yes/no)	Physical condition	Main uses	General remarks
Rivers					
Boreholes					
Piped water					
Private vendors					
Roof catchment					

APPENDIX III: Key Informant Guide

This interview guide collects data on water use sustainability and management by non-resident students of UoK. Moreover, the information collected will be confidential and specifically used only for the abovementioned purpose. Thank you.

A. **Demand**

   i.   The existing non-resident student population within Kabianga University town

   ii. The population growth rate of non-resident students of the University of Kabianga

   iii. What are the major uses of water?

   iv. Do you think that the water sources for non-resident students are reliable and sustainable?

B. **Feasibility**

   i.   Outline the existing sources of water.

   ii. Exploration potential of water sources (dams, boreholes, shallow wells, natural springs and roof water harvesting)
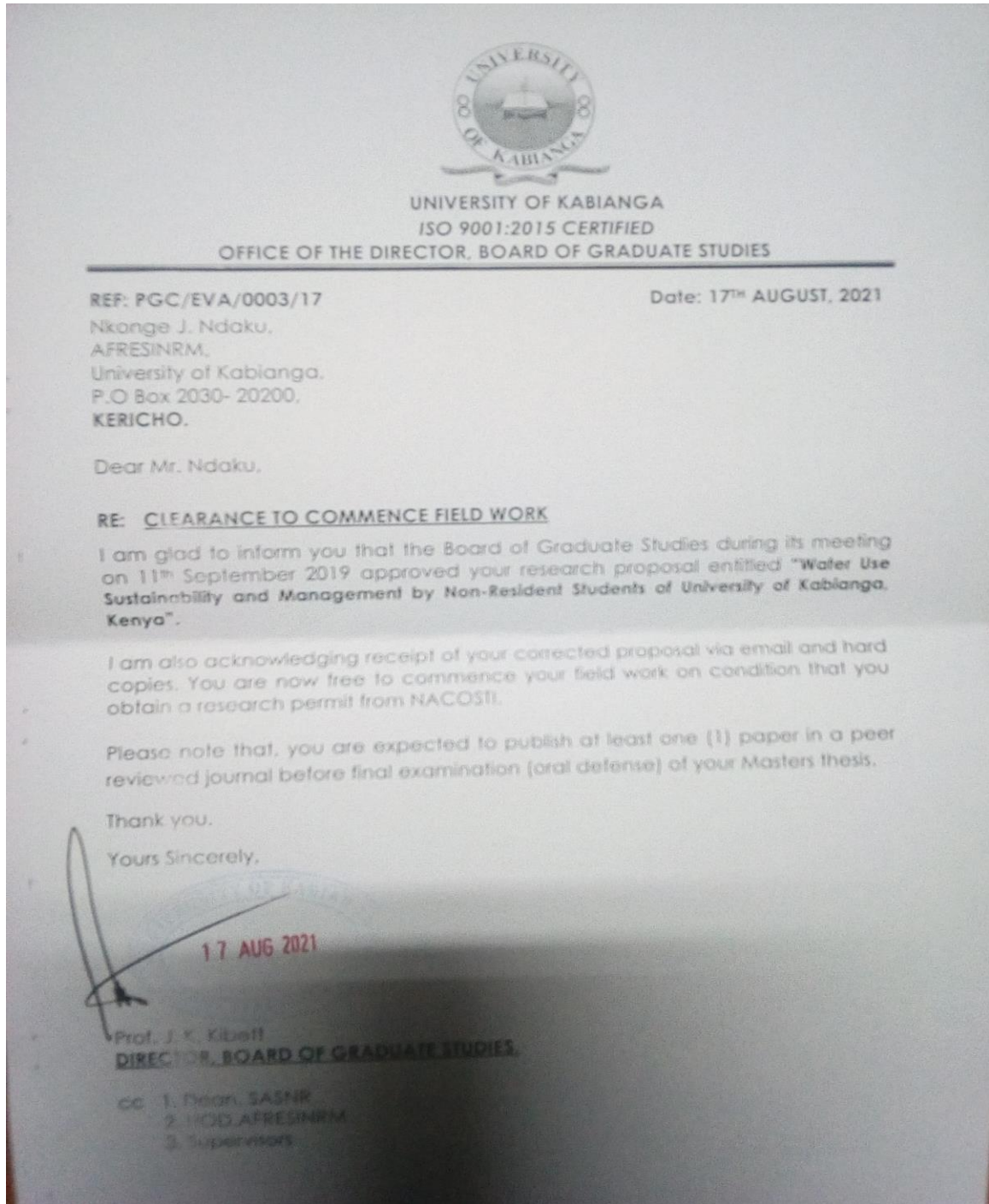
C. **Suitability**

   i.   Presence of Water Company

   ii. Ways of conserving/replenishing water sources

   iii. What are the plans for ensuring a sustainable water supply within the town?

APPENDIX IV: Observation Schedule

S/No	Observable Parameter	Remarks
1	Sources of Water	
2	Student Hostels	
3	Water Tanks	
4	Vendors carrying water	
5	Students accessing water	
6	Environmental factors, dry season,	
7	University of Kabianga infrastructure	

APPENDIX V: Letter of Clearance by Board of Graduate Studies.

UNIVERSITY OF KABIANGA
ISO 9001:2015 CERTIFIED
OFFICE OF THE DIRECTOR, BOARD OF GRADUATE STUDIES

REF: PGC/EVA/0003/17   Date: 17TH AUGUST, 2021

Nkonge J. Ndaku,
AFRESINRM,
University of Kabianga,
P.O Box 2030- 20200,
KERICHO.

Dear Mr. Ndaku,

RE: CLEARANCE TO COMMENCE FIELD WORK

I am glad to inform you that the Board of Graduate Studies during its meeting on 11th September 2019 approved your research proposal entitled "**Water Use Sustainability and Management by Non-Resident Students of University of Kabianga, Kenya**".

I am also acknowledging receipt of your corrected proposal via email and hard copies. You are now free to commence your field work on condition that you obtain a research permit from NACOSTI.

Please note that, you are expected to publish at least one (1) paper in a peer reviewed journal before final examination (oral defense) of your Masters thesis.

Thank you.

Yours Sincerely,

1 7 AUG 2021

Prof. J. K. Kibett
DIRECTOR, BOARD OF GRADUATE STUDIES.

cc   1. Dean, SASNR
     2. HOD, AFRESINRM
     3. Supervisors

APPENDIX VI: NACOSTI Research Permit

Ref No: **117701**

Date of Issue: **29/August/2022**

RESEARCH LICENSE

This is to Certify that Mr.. NDAKU NKONGE JAVIS of University of Kabianga, has been licensed to conduct research in Kericho on the topic: WATER USE SUSTAINABILITY AND MANAGEMENT BY NON-RESIDENT STUDENTS OF UNIVERSITY OF KABIANGA, KENYA. for the period ending : 29/August/2023.

License No: **NACOSTI/P/22/19908**

117701
Applicant Identification Number

Director General
NATIONAL COMMISSION FOR
SCIENCE,TECHNOLOGY &
INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document,
Scan the QR Code using QR scanner application.

REPUBLIC OF KENYA

**NATIONAL COMMISSION FOR
SCIENCE,TECHNOLOGY & INNOVATION**

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

The Grant of Research Licenses is Guided by the Science, Technology and Innovation (Research Licensing) Regulations, 2014

CONDITIONS

1. The License is valid for the proposed research, location and specified period
2. The License any rights thereunder are non-transferable
3. The Licensee shall inform the relevant County Director of Education, County Commissioner and County Governor before commencement of the research
4. Excavation, filming and collection of specimens are subject to further necessary clearence from relevant Government Agencies
5. The License does not give authority to tranfer research materials
6. NACOSTI may monitor and evaluate the licensed research project
7. The Licensee shall submit one hard copy and upload a soft copy of their final report (thesis) within one year of completion of the research
8. NACOSTI reserves the right to modify the conditions of the License including cancellation without prior notice

National Commission for Science, Technology and Innovation
off Waiyaki Way, Upper Kabete,
P. O. Box 30623, 00100 Nairobi, KENYA
Land line: 020 4007000, 020 2241349, 020 3310571, 020 8001077
Mobile: 0713 788 787 / 0735 404 245
E-mail: dg@nacosti.go.ke / registry@nacosti.go.ke
Website: www.nacosti.go.ke