DETERMINANTS OF FINANCIAL VIABILITY AMONG REGULATED WATER SERVICE PROVIDERS IN KENYA

BY

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DECLARATION

I declare that this dissertation is my original work and has not been previously published or submitted elsewhere for award of a degree. I also declare that this contains no material written or published by other people except where due reference is made and author duly acknowledged.

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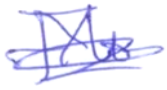

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ABSTRACT

The management of water resources as an economic good has been a subject of global discourse since the Dublin Conference in 1992. This conference highlighted the importance of treating water as an economic good and recommended the use of full-cost pricing to ensure the financial viability of water utilities. The principles established at the Dublin Conference influenced the development of Agenda 21 and the subsequent adoption of the UN's Sustainable Development Goals (SDGs), emphasizing the provision of water and sanitation for all as a basic human right. The primary objective of this study was to determine the factors that affect the financial viability of regulated water service providers in Kenya. Specifically, the study assessed the effect of water tariff, non-revenue water, and personnel expenditure on the financial viability of water service providers in Kenya. The study was guided by stakeholder theory, agency theory, and public utility theory. Secondary data were utilized, sourced from the 89 public water companies in Kenya licensed by WASREB. The data spanned from 2016 to 2023, providing an eight-year period and enabling the creation of a panel dataset. The study covered the period of 2016 to 2023 as the Water Act 2016 was operationalized following a revision of the Water Act 2002, which brought major changes to the water and sanitation sector informed by the Constitution of Kenya 2010. A data collection sheet in Microsoft Excel was used as the data collection tool. Panel data were accessed from the Impact Performance Reports of Kenya's Water Services Sector available on WASREB's website. Descriptive and correlational methods of data analysis were employed to examine the relationship and effect of water tariff, non-revenue water, and personnel expenditure on financial viability of the 89 regulated water service providers in Kenya. To ensure the accuracy of the regression results, diagnostic tests were conducted to assess multicollinearity, autocorrelation and heteroskedasticity. The research questions presented in the study formed the basis for hypothesis testing. Each hypothesis was either rejected or retained depending on the results. Using a 95% confidence interval, the null hypothesis was rejected whenever the p-value was less than 0.05, while the alternative hypothesis was accepted. STATA was used for data analysis as it provided the tools and features required for data transformation and regression diagnostics. The regression analysis showed that water tariffs had a positive but insignificant effect on financial viability, while non-revenue water had a negative but insignificant effect. Personnel expenditure had a positive and significant effect, indicating that efficient management of staff costs enhances cost recovery. The study concludes that tariffs and NRW alone do not guarantee financial viability. The study highlights the role of personnel expenditure, suggesting that resources allocated to staff can improve efficiency when properly managed. Therefore, WSPs should invest in training, performance management systems, and outsourcing of non-core functions to enhance productivity and ensure that personnel costs translate into improved service delivery and cost coverage. WASREB should strengthen enforcement of benchmarks for personnel expenditure as a percentage of O&M and staff to connection ratios to minimize inefficiencies and prevent wage costs from undermining operational sustainability. By ensuring that personnel expenditure is aligned with efficiency and productivity, WSPs can improve financial viability.

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ABBREVIATIONS AND ACRONYMS

JICA	Japanese International Cooperation Agency
NACOSTI	National Commission for Science, Technology, and Innovation
NRW	Non-Revenue Water
O&M	Operational and Maintenance
PFM	Public Finance Management
RBT	Resource-Based Theory
SAPs	Structural Adjustment Policies
SDGs	Sustainable Development Goals
SRC	Salaries and Remuneration Commission
SSPs	supplementary service providers
UN	United Nations
VIF	Variance Inflation Factor
WASH	water, sanitation, and hygiene
WSPs	Water Service Providers

TERMS AND DEFINITIONS

Financial viability: Financial viability refers to the capacity of an organization to sustain its operations and achieve its objectives over the long term. It involves the ability to generate adequate revenue to cover operating expenses, service debts, and, where possible, support growth without compromising service delivery (Gichuru & Otieno, 2013).

Non-revenue water (NRW): NRW is the difference between the volume of water put into a distribution system and the amount that is billed and paid for by customers. It arises from physical losses (such as leaks), commercial losses (like illegal connections, meter errors, or uncollected bills), and authorized but unbilled uses. In Kenya's water sector, NRW level of less than 25% is regarded as the benchmark for good performance. (WASREB, 2024; Al-Washali et al., 2019; Wyatt, 2010).

Operation and maintenance (O&M) costs: O&M costs refer to the recurring expenditures required to keep a water supply system functioning effectively. These include the day-to-day expenses of producing, treating, distributing, and managing water services, as well as the maintenance and periodic rehabilitation of assets to ensure continued service delivery (Ying et al., 2010).

Personnel Costs: Personnel costs represent all expenditures an organization incurs on its workforce. These include salaries, wages, benefits, allowances, training, welfare, and other human resource–related expenses. Personnel expenditure as a proportion of operation and maintenance (O&M) costs measures the share of a utility's operating budget spent on staff-related expenses, including salaries, wages, and allowances. In Kenya's water sector, an allocation of less than 30% of O&M costs to personnel expenditure is considered ideal, as it indicates a balanced approach to managing human resources while maintaining financial sustainability (Orwa et al., 2022; WASREB, 2024).

Regulated water service providers: A regulated water service provider is any licensed entity whether a company, public benefit organization, or individual that delivers water services within a defined service area under the oversight of the Water Services Regulatory Board (WASREB), as established in the Water Act, 2016 (Republic of Kenya, 2016).

The water sector in Kenya: It comprises institutions and actors involved in the management of water resources and the delivery of water and sanitation services. Guided by the Constitution of Kenya (2010) and the Water Act (2016), the sector operates under a devolved framework where the national government oversees policy and regulation, while county governments are mandated to provide water services through water service providers (Ministry of Water, Sanitation and Irrigation, 2020).

Water tariff: A water tariff is the price applied to water supplied by a utility through a piped network to its consumers. It reflects the costs involved in delivering the service, including abstraction, treatment, storage, and distribution. A water bill may include fixed elements such as access or service charges as well as variable elements based on the actual volume of water consumed (Andres et al., 2021).

CHAPTER ONE

INTRODUCTION

This chapter contains the background of the study, a description of the Kenyan water sector, statement of the problem, research objectives, research questions, justification of the study, significance of the study and scope of the study.

1.1 Background of the Study

Water is an essential natural resource of global significance, serving as both a vital public asset and a fundamental service. Its importance extends to supporting the achievement of nearly all Sustainable Development Goals (SDGs). However, water resources face significant strain, and inadequate investment in the sector has resulted in insufficient water service delivery. If current trends continue, the world is projected to experience a 40% deficit between water demand and supply by 2030, with 10% of the global population already living in countries experiencing high or critical water stress. Additionally, 1.8 million people die annually due to inadequate water, sanitation, and hygiene (WASH) services, while 80% of the world's wastewater is discharged into the environment untreated (Khemka et al., 2023).

A significant portion of households worldwide lacks access to a safe and sufficient water supply. The rapid expansion of urban areas in developing regions, combined with the slow pace of piped network expansion by existing utilities, suggests that reliance on supplementary service providers (SSPs) for water would likely increase. By 2030, nearly one billion individuals primarily in African and Asian cities will depend on SSP water supplies, which often fail to meet safety standards. Notably, over two-thirds of these individuals will belong to the two lowest wealth brackets (Misra & Kingdom, 2022).

The concept of treating water as an economic good was first recommended in 1992 during 'The International Conference on Water and the Environment' in Dublin. The conference established four key principles, with the fourth principle recognizing water's economic value

(Meran et al., 2021). In addition to advocating for water as an economic good, the conference also recommended the adoption of full-cost pricing, which includes operational and maintenance expenses, finance charges, and provisions for future upgrades and rehabilitation (McPhail et al., 2012). For utility companies to remain financially viable, they must generate sufficient revenue to cover costs, repay debts, and invest in future infrastructure (Huenteler et al., 2017).

The Dublin Conference laid the foundation for Agenda 21, which was adopted by the United Nations (UN) in 1992 as a framework for sustainable development. As a result, the agenda promoted tariff systems that reflect actual water costs while considering consumers' ability to pay. Both the Dublin Principles and Agenda 21 had a profound influence on international water policy (Meran et al., 2021). In 2015, the United Nations introduced the SDGs, which were adopted by member nations. Among them, SDG 6 emphasizes universal access to water and sanitation, reinforcing the principle that water is a fundamental human right (Spijkers, 2020).

Achieving universal coverage in water and sanitation remains a challenging and urgent goal, which has been incorporated into the United Nations SDGs for the 2015–2030 period. The SDGs play a crucial role in global development discourse and are central to national agendas. However, one of the key obstacles to this objective is the growing global population, which is projected to reach 10.2 billion by 2050. Additionally, water scarcity is expected to worsen as competition for this critical resource intensifies (Alaerts, 2019). Water services are often managed by the public sector due to their classification as a natural monopoly. However, when a public utility operates as a monopoly, challenges such as diminished service quality, reduced incentives for efficiency, and decreased cost-effectiveness can arise (Lombardi et al., 2019). Most water utilities are subject to political or regulatory price controls that keep tariffs

low while aiming to cover operating and capital costs, which depend on labor rates, infrastructure conditions, maintenance policies, and water availability (Zetland & Gasson, 2012).

In the European Union, achieving full financial cost recovery for the water supply and sanitation sector remains difficult. One-third of EU member states achieve cost recovery rates equal to or greater than 100% for water supply and sanitation services, while another third report cost recovery levels below 90%. Across the EU, water tariffs generate approximately 70% of the revenue required for water service provision, with public financing covering the remaining 30% (Farnault & Leflaive, 2024). In Asia, rapid population growth, urbanization, and climate change have exacerbated water supply challenges. This is particularly concerning in densely populated areas often located in high-risk regions, such as flood-prone zones, river deltas, and coastal areas (Janusz-Pawletta et al., 2022).

In Sub-Saharan Africa, water utilities were privatized primarily due to the influence of international donors. This shift was driven by the poor performance associated with centralized public sector ownership. Key reforms included tariff adjustments and performance contracts that required firms to meet specific objectives (Bayliss, 2003). One of the major challenges facing African water utilities is the high rate of NRW. In Sub-Saharan Africa, NRW exceeds the recommended threshold of 23%, leading to an estimated annual revenue loss of approximately $1.4 billion. Many water service providers in the region operate with aging distribution networks, which significantly contribute to high NRW levels (Shushu et al., 2021). Additionally, Africa's population has grown from approximately 190 million in 1990 to 700 million in 2020. Rapid urbanization in African cities has increased the demand for water, yet governments have not invested sufficiently in water provision. For example, Lagos, one of the

most populous cities on the continent, has some of the lowest levels of piped water access (African Development Bank Group, 2022).

A well-functioning public sector workforce plays a critical role in supporting productive economies and delivering essential services. In OECD countries, approximately 9.5% of GDP and 20% of public spending are allocated to compensating public sector employees (OECD, 2021). In South Africa, public sector wages accounted for 14% of GDP and 37% of total government spending (Mbaleki, 2021).

Kenya's water sector faced significant challenges in the 1990s, similar to those observed in other regions. The prevailing assumption was that these issues stemmed from the over-centralization of organizations responsible for water supply. Additionally, uneconomic tariffs contributed to financial constraints that hindered water supply agencies from maintaining infrastructure or making necessary investments. To address these concerns, Sessional Paper Number 1 of 1986 on Economic Management for Renewal recommended the decentralization of water services. It also introduced market-reflective pricing to ensure that water tariffs fully covered operational costs. Furthermore, the privatization of Kenya's water sector was part of the Structural Adjustment Policies (SAPs) in the 1990s, leading to the establishment of water companies under the Companies Act (K'Akumu & Appida, 2006).

NRW remains a critical challenge in Kenya's water sector, with annual losses estimated at 45%. Financially, this translates to a Ksh 10.5 billion loss from a total sector turnover of Ksh 3.2 billion (WASREB, 2022). In 2020/21, only 7 out of 87 water service providers achieved NRW levels of 25% or below, highlighting the widespread inefficiencies in water distribution. In response, the Ministry of Environment, Water, and Natural Resources, in collaboration with the Japanese International Cooperation Agency (JICA), developed strategies to manage NRW. This partnership supports multiple WSPs through planning, monitoring, and assistance aimed at reducing NRW and increasing the water available to consumers. Despite these efforts, NRW

continues to threaten the long-term financial sustainability of many WSPs in Kenya (Ernest Ngolo & Kidere, 2023).

Effective public finance management is crucial for Kenya's county and national governments. The Public Finance Management (PFM) Act, 2012, operationalized through the PFM Regulations of 2015, was enacted to enhance fiscal discipline. However, the public sector wage bill remains the largest component of recurrent expenditure, particularly at the county level (Sindani, 2020). In 2020/21, the wage bill accounted for 36.89% of recurrent expenditure, exceeding the 35% benchmark set by the PFM Regulations, 2015 (Salaries and Remuneration Commission (SRC), 2022).

In Kenya's water sector, personnel costs represent a significant portion of operational and maintenance (O&M) expenses. The Water Services Regulatory Board (WASREB) has set benchmarks to ensure cost efficiency in water service provision. Personnel costs should not exceed 30% for large and very large water companies, 40% for medium-sized companies, and 45% for small companies as a share of total O&M costs (WASREB, 2022). However, in 2021, 90% of large and very large companies, 56% of medium-sized companies, and 35% of small companies had personnel costs exceeding these benchmarks, posing financial sustainability challenges for the sector.

1.1.1 The Kenya water sector

Article 43 of the Kenyan Constitution articulates the right to water and sanitation. Article 21 of the constitution requires the state to take efforts, including legislative and policy setting to accomplish these rights (Kenya National Commission on Human Rights, 2017). In addition, the Constitution 2010 introduced brought about shared responsibilities between the county government and the national government. In Kenya's water governance system, both national and county governments share the responsibility for water sector development and service provision. The role of the national government include protection of water, ensuring adequate

residual water, hydraulic engineering, and dam safety while the county government is in charge of provision of water and sanitation services (Government of Kenya, 2010).

Water and sanitation sector in Kenya has experienced massive reforms. Regulation of the sector began with the National Policy on Water Resources Management and Development established in 1999 and later the government developed and implemented the Water Act 2002. Enactment of Water Act 2002 aimed to improve among others the supply of good quality sufficient water, safe waste management and service delivery efficiency (Maryline Akinyi & Odundo, 2018).

The Water Act, 2016 established institutions with distinct functions to manage the water and sanitation sector in Kenya Water Services Regulatory Board (WASREB), was created to establish standards and regulate the water and sanitation sub-sector. The Water Tribunal resolves disputes, while Water Works Development Agencies ensure efficient and economical water service provision. The Water Sector Trust Fund finances investments benefiting the poor. Water Service Providers deliver water and sewerage services according to acceptable business principles. The Ministry of Water, Sanitation, and Irrigation oversees the sector, handling policy formulation, coordination, and resource mobilization (USAID, 2022).

The county governments are required to establish water service providers that are in compliance to commercial viability standards set by WASREB (GOK, 2016). The Water Regulations 2021 have explicitly indicated ring fencing of all funds generated by a water service provider from the county government in that, revenues generated by a water company do not form part of funds of county governments (GOK, 2021). If a water company have more revenue than expenditure in a particular year, the excess cannot be paid to the county government but rather a water service provider is required to operate a contingency fund to cater for maintenance of the water system (GOK, 2016). Water sales should be ring-fenced and utilized for reinvestment in order to ensure the sector's viability (Kenya National Commission

on Human Rights, 2017). Water sector in Kenya comprises of 92 regulated Water Service Providers and approximately 6,985 small scale service providers as of 2020 (WASREB, 2021).

It is becoming increasingly critical for water utilities to develop fiscally and economically viable water prices that allow them to offer essential services to their customers on a consistent basis (Nauges & Whittington, 2017). A water tariff refers to the charge imposed for water delivered to consumers by a water service provider through a piped network to its consumers. Costs related to extraction, treatment, storage and distribution determines a customer's total water bill. In order to set up a tariff, a water regulator or a water utility needs to understand the cost elements from production to the point the water is consumed (Andrés et al., 2014). Fuente et al., 2021 defined a water tariff as a set of criteria used by a company to determine how much consumers must pay on a monthly basis in return for a certain level of service. When setting a water tariff, the company has to ensure that householders pay an acceptable price based on the available water for supply, but the price should also be high enough to ensure a realistic profit for the water companies and to operate sustainably. Importantly, water pricing should aim to encourage effective water usage in order to promote the long-term viability of water resources. Water and sanitation pricing process includes involvement of a number of stakeholders such as regulators and consumers(Sahin et al., 2017).

Water prices can range from tariff that does not change based on the amount of water consumed by the customer to that which varies based on the water consumed. Tariffs can be consistent year-round or change periodically. Different tariffs can be used to compute water bills for different sorts of customers such as domestic, commercial and industrial consumers(Fuente et al., 2021). The objective of water tariffs include efficiency, equity and sustainability(Termes-Rife & Bernardo, 2015). Efficiency objective is met when the price of water is equal to the cost of delivering it. Efficiency ensures that both the direct costs of obtaining and supplying water are taken into account. The equity criteria refers to the idea of

providing an affordable supply of water to all residents of a community for domestic use. Given that water is an essential commodity, a solely market-based distribution of water between competing users would deny disadvantaged citizens of access to a safe and dependable supply. When the revenues from water sales are adequate to cover the yearly operating and maintenance costs as well as the fixed costs of a water delivery system, it is said to be sustainable (Wichelns, 2013).

Water losses (non-revenue water) and the consequent financial losses are a significant challenge for water delivery businesses (Ewa et al., 2019). NRW refers to the difference between the total amount of water entering the water supply network from various sources such as water treatment plants, borehole systems or imported bulk water supplies, and the total amount of water that consumers, including domestic, commercial, industrial and institutional users, are and are charged for (Farley et al., 2008). NRW is categorised into physical and commercial losses. Physical losses emanate from leakages in the distribution system as a result of poor maintenance of the of the distribution system and inadequate active leakage control. Commercial losses are as a result of a range of factors including inaccurate meter readings that result in undercharging customers, mistakes made in handling data, and the illegal act of stealing water in different ways. Commercial losses may also arise from the volume of water consumed by a utility for its operational needs, firefighting purposes, and distribution to specific consumer groups free of charge (Van Den Berg, 2014).

1.1.2 Financial viability

Lace & Koleda, 2012 defines financial viability as is the allocation and use of financial resources that allows a firm to maintain its equilibrium in the near term while also providing long-term development. Financial viability entails managing the company's resources in order to pay operational costs, provide funds for investment and meet financial obligations such as loan (Christian & Airativich, 2020). In the water sector, water service providers are expected

to fully recover the costs incurred in provision of water and sanitation services. Cost recovery implies that the service provider's total income matches (or surpasses) the cost of providing water and sanitation services. A steady income source helps the utility avoid cash flow and financial difficulty.

Full cost recovery is seen as a requirement for network expansion and, as a result, access to water for low-income households who are not served by formal service provision(Rusca & Schwartz, 2018). The provision for cost recovery is a manifestation of the user pays concept. The user pays concept is a widely accepted economic principle that states that users of services should pay for those services and consequences thereof (Lindhout & van Rijswick, 2015). Utilities with poor financial viability are unable to expand coverage due to a lack of internal money, while donors and governments are hesitant to invest in their loss-making systems. The costs considered under full costs recovery include direct costs, resource and environmental costs. The direct costs comprise of operation and maintenance; and administrative costs (Tsitsifli et al., 2017). Operational costs are those that are incurred during running and monitoring the system as per the laid down policies and procedures. Maintenance costs are incurred while assessing the system's status, maintaining, repairing, and replacing components. A relatively higher proportion of operation and maintenance cost is utilised paying staff salaries and electricity bills while allocating lower costs to maintenance of assets (Mohanty & Rout, 2020).

1.2 Statement of the Problem

Globally, progress toward achieving SDG 6, which aims to ensure universal access to water and sanitation, lags behind, requiring a fourfold acceleration in efforts to meet its 2030 targets (United Nations, 2023). In Africa, only 78% of the population had access to safe drinking water in 2020, indicating the need to quadruple efforts to close the gap (UNICEF, 2022). In Kenya, water service providers (WSPs) have experienced declining ability to cover operations and

maintenance (O&M) costs. WASREB Impact Reports (2018/19–2022/23) show O&M cost coverage dropped from 103% in 2019/20 to 95% in 2022/23 below the acceptable 99% benchmark signifying reduced financial viability. Non-revenue water averaged 45%, nearly double the WASREB benchmark of 20–25%, with 91% of WSPs classified as poor performers. Over the same period, 67% of utilities exceeded acceptable staff cost ratios (30%, 40%, and 45% for large, medium, and small utilities respectively), constraining funds for other operations and diminishing service quality. Moreover, in 2021/22 only 45% of WSPs operated with justified tariffs, largely due to political interference and weak capacity, hindering investment and reducing customers' willingness to pay (Andrés et al., 2021).

Prior studies have examined specific determinants of financial performance in Kenya's water utilities, they often analyzed these factors in isolation. For instance, Julius and Kalunda (2021) focused on how pricing, financing, and efficiency influence financial sustainability, while Onsomu (2013) examined non-revenue water, supply reliability, and staff productivity using data from a single utility. However, these studies did not concurrently test the joint effect of tariff structures, non-revenue water, and personnel expenditure on financial viability, nor did they employ panel data to capture variations across utilities and over time. This methodological gap limits the understanding of how these key operational and financial variables interact to influence the overall sustainability of water service providers (Mawia, Okech, & Kalunda, 2021; Andrés et al., 2021).

The declining financial viability of Kenya's regulated water service providers presents a critical challenge to the sustainability of water service delivery. With operations and maintenance cost coverage falling below the required benchmark, high levels of non-revenue water, excessive staff costs, and politically influenced tariff structures, many WSPs are struggling to remain financially viable (World Bank, 2017). Despite existing studies on financial sustainability, there remains a gap in understanding how the interplay of tariffs, non-

revenue water, and staff costs impacts financial viability across all regulated WSPs. This study therefore sought to assess the financial viability of regulated water service providers in Kenya, focusing on all regulated providers.

1.3 Research Objectives

The overall objective of this study was to assess the factors that affect financial viability of regulated water service providers in Kenya. The specific objectives included:

i. To evaluate the effect of water tariff on financial viability of regulated water service providers in Kenya
ii. To assess the effect of the non-revenue water on financial viability of regulated water service providers in Kenya
iii. To evaluate the effect of personnel costs on financial viability of regulated water service providers in Kenya

1.4 Research Questions

i. What is the effect of water tariffs on financial viability of regulated water service providers in Kenya
ii. What is the effect of the effect of the non-revenue water on financial viability of regulated water service providers in Kenya
iii. What is the effect of personnel costs on financial viability of regulated water service providers in Kenya

1.5 Justification of the Study

The study proposed here is crucial in the context of the looming Sustainable Development Goals (SDG) deadline, with particular emphasis on SDG 6, which aims to guarantee universal access to safe water and adequate sanitation. The significance of this research is evident, given the prevailing challenges in the water sector, especially in Africa where a significant portion

of the population still lacks access to clean drinking water. Operational and financial issues affect many water service providers, with most failing to achieve full cost coverage, resulting in difficulties in maintaining infrastructure and delivering quality service. The study aims to contribute to the existing knowledge and provide insights into the factors affecting financial viability in the water sector, potentially offering valuable guidance for policymakers, utility companies, and stakeholders in achieving SDG 6 targets and ensuring sustainable access to clean water and sanitation for all.

1.6 Significance of the Study

In Kenya, the water sector plays a critical role in supporting public health, economic development, and environmental sustainability. Ensuring the financial viability of water service providers is essential to guaranteeing the consistent and reliable provision of safe water to consumers across the country.

1.6.1 Scholars

The study will contribute to the theoretical knowledge on the factors affecting financial viability in regulated water service providers in Kenya and what the water companies can focus on to enhance full cost recovery.

1.6.2 Water service providers

Water companies may use the recommendations of the study on how water tariffs, non-revenue water and personnel costs affect their full cost recovery and hence financial viability.

The study's findings hold significant implications for water companies in Kenya. Examining the impact of water tariffs, non-revenue water, and personnel costs on full cost recovery and financial viability may provide recommendations that can guide these companies in improving their operations. Implementing the study's recommendations can help water companies

enhance their financial management practices, ultimately leading to more efficient and effective service delivery for the benefit of all stakeholders.

1.6.3 Policy makers

The research is important to the policy makers in the water sector who include but not limited to the Ministry of Water and Sanitation and Irrigation, WASREB and Water Works Agencies. The policy makers may accord WSPs assistance through initiatives that can aid the water utilities to recover their costs and hence provide water for all as stipulated in the Constitution and become sustainable while doing it.

1.7 Scope of the Study

The study focused on the concept of water tariffs, non-revenue water, and personnel costs and how they affected the financial viability of water service providers. The study targeted all the companies licensed by WASREB. The study utilised secondary data for all the water companies for a period of 9 years.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter encompasses the conceptual framework, variable operationalization, and empirical analysis. It starts with an exploration of the theoretical framework of the study followed by an assessment of the empirical literature is included, which references the contributions of previous researchers and highlights the unaddressed aspects within the current body of work.

2.2 Theoretical Review

Theories serve as the fundamental components that shape an individual's perspective on the universe, encompassing a compilation of ideas, postulates, and propositions (Rudestam & Newton, 2014). The theoretical framework serves as the foundation upon which all pertinent information for a study is built. The application of theory is considered to be of utmost importance in the continuous effort to extend knowledge (Fox, Gardner, & Osborne, 2015). The study approach was grounded on three theories, namely the public utility pricing theory, the resource-based theory, and the agency theory.

2.2.1 Agency theory

Agency theory explains the conflicts that can emerge when ownership and control of a firm are separated. Berle and Means (1932) were among the first to note that the division between managers (agents) and shareholders (principals) creates opportunities for misaligned incentives. Jensen and Meckling (1976) later formalized the theory, describing how agency costs arise from the need to monitor agents and align their behavior with the principals' objectives. Such conflicts may undermine organizational efficiency and profitability, as

managers often pursue personal goals or short-term performance targets that do not necessarily reflect shareholder or public interests (Eisenhardt, 1989).

Managers may manipulate earnings reports or prioritize projects that benefit their own standing rather than advancing the organization's long-term sustainability (Setiawan, 2020). Control mechanisms such as performance monitoring, incentive systems, and governance structures are therefore required to minimize opportunistic behavior and harmonize diverging interests between principals and agents.

Agency Theory underpins this study as it explains how managerial behavior and governance structures influence the financial viability of regulated WSPs. In the Kenyan water sector, agency theory is particularly relevant given the governance structure of regulated WSPs. Here, county governments act as the principals on behalf of citizens, while the management teams of WSPs serve as agents. Agency problems can occur when managers pursue objectives such as overstaffing, political patronage, or under-enforcement of tariff collection, which may weaken financial viability. High personnel expenditures, persistent non-revenue water, and poor cost recovery can be interpreted through the lens of agency conflicts, highlighting the need for robust governance frameworks. Aligning managerial motivations with the public interest requires clear regulatory benchmarks, performance-based contracts, and active oversight by WASREB and county governments.

Research shows that governance arrangements strongly influence the effectiveness of boards in balancing competing interests. Royo et al. (2019) argue that the interaction between boards and multiple stakeholders may push directors to prioritize agendas that conflict with public accountability. Similarly, Simpson (2014) notes that politically appointed directors may lack the independence to act in the best interests of citizens, raising questions about their ability to make decisions free from political interference. These dynamics illustrate that without safeguards, agency problems can undermine the financial performance and sustainability of

WSPs. Agency theory, therefore, provides a valuable framework for analyzing the governance and financial challenges faced by Kenyan utilities.

2.2.2 Resource-based theory

Using an organization's strengths and competencies as a strategic advantage is central to Resource-Based Theory (RBT). It suggests that businesses with scarce, high-quality assets are better equipped to compete successfully. Regulated water service companies' ability to stay in business heavily depends on their access to and effective management of available resources. It is possible to distinguish between successful and unsuccessful water service providers in Kenya by applying resource-based theory and pinpointing the essential resources and competencies contributing to financial sustainability. Resources, including infrastructure, human capital, technological capital, and financial capital, are highlighted as crucial in this approach. Academics have studied the effect of utilities' resources and capacities on their bottom lines. For instance, Julius and Okech, (2021) examined how water firms in Kenya fared financially after investing in infrastructure. The researchers concluded that increased investment in infrastructure had a beneficial effect on long-term economic health. The effect of technology adoption on the bottom lines of Kenya's water utilities was also studied by Otundo (2022). Technology improvements, such as automated meter reading and water management systems, were shown to benefit financial sustainability, as they reduced non-revenue water and improved cost control.

Water service providers in Kenya have been studied previously in terms of how resources and competencies affect their financial sustainability. Human capital's impact on financial performance in Kenya's water industry was studied by Owako and Nyangara, (2021, June), for instance. Through increased productivity and customer satisfaction, they discovered that training and development investments favorably affect a company's bottom line. Also, Garlinia et al., (2018) dug at how financial capital affects water providers' bottom lines in

Kenya. They stressed the need to have sufficient funds and allocate capital effectively to guarantee financial sustainability.

Resource based theory emphasizes an organization's internal resources and competencies as the foundation for achieving a competitive advantage. While the theory has been widely applied in strategic management, it has been criticized for several limitations. One major critique is that it struggles to explain how firms maintain a competitive advantage in dynamic and unpredictable environments. Another criticism is that RBT primarily focuses on internal resources while largely ignoring exogenous factors such as regulatory changes, market dynamics, and technological advancements (Utami & Alamanos, 2023).

2.2.3 Public utility pricing theory

Public utility pricing theory emerged from welfare economics and public finance, with seminal contributions by Hotelling (1938) on marginal cost pricing and Boiteux (1960) on Ramsey pricing. The theory emphasizes that pricing in public utilities such as water, electricity, and transport must balance efficiency, equity, and long-term financial sustainability. Its central premise is that utilities, which provide services with public good characteristics, should recover costs while ensuring that services remain accessible and affordable.

The theory highlights several important concepts in utility pricing. Marginal cost pricing suggests that charges should reflect the additional cost of supplying one more unit of service, while Ramsey pricing allows for variation across customer groups depending on demand elasticity to minimize welfare losses while covering total costs. In practice, cross-subsidization is often applied, where higher-income or commercial consumers pay more to support lifeline tariffs for low-income households. Utilities may adopt different tariff structures, including single-part tariffs (fixed or volumetric), increasing block tariffs (IBTs), or two-part tariffs that combine a fixed service fee with volumetric charges (Whittington et al.,

2015). Each of these approaches has implications for financial viability, affordability, and equity.

In Kenya, tariff setting for regulated water service providers (WSPs) is guided by the Water Services Regulatory Board (WASREB) under the Water Act (2016). Tariffs are expected to cover operation and maintenance (O&M) costs while ensuring affordability, particularly for vulnerable groups. Several studies have examined the impact of tariff structures on the financial sustainability of Kenyan utilities. Garlina et al. (2018) showed that tariff design significantly influences revenue generation and overall viability, while Chepkemoi et al. (2019) highlighted the difficulty of balancing cost recovery with affordability, as poorly designed tariffs can reduce willingness or ability to pay. Ikram and MacDonald (2020) found that optimal tariff reforms are essential for achieving both revenue sufficiency and consumer welfare, while Julius and Okech (2021) demonstrated that although subsidies promote access, they may compromise financial independence if not properly managed. These findings illustrate that tariff policy plays a central role in the financial performance of WSPs and that achieving the right balance between affordability and cost recovery remains a key challenge.

Despite its usefulness, public utility pricing theory has limitations. It assumes rational consumer behavior and continuous demand responses, which oversimplify human decision-making (Rizza, 2008). In reality, water consumption patterns are shaped not only by price but also by cultural, behavioral, and psychological factors (GCA, 2023). Moreover, the theory underestimates the impact of political and institutional dynamics. In Kenya, for example, political interference in tariff approvals and delays in regulatory processes often distort pricing decisions, undermining the efficiency of cost recovery mechanisms (Otieno, 2024).

The theory provides a useful framework for analyzing how pricing policies influence the financial viability of regulated water service providers. In the Kenyan context, its application demonstrates the importance of tariff structures that recover O&M costs while

addressing affordability concerns through mechanisms such as lifeline blocks. However, for the theory to hold in practice, tariff design should also account for behavioral, political, and institutional realities that extend beyond the theory's assumptions, ensuring that pricing policies achieve both financial sustainability and social equity.

2.3 Empirical Review

This section analyzed and integrated the results of previous empirical research on the factors that affected the sustainability of Kenya's regulated water service providers. The section presented the results of previous studies' approaches, significant findings, and limitations to identify gaps in the literature and justify the need for the proposed study to fill them.

2.3.1 Water tariff and financial viability

Julius and Okech (2021) conducted an empirical study to examine the determinants of financial health among Kenya's regulated water service providers (WSPs). Using a quantitative research design, the authors applied regression analysis to assess how water pricing, infrastructure financing, utility efficiency, and subsidies influence the long-term financial viability of the sector. Primary data were collected through questionnaires administered to a cross-section of WSPs across the country. The study found that financial viability is significantly influenced by these operational and financial factors, with water pricing and utility efficiency emerging as key predictors. Moreover, the authors observed that government regulation exerts a moderating effect, shaping how these variables interact and ultimately determining utilities' financial outcomes. This highlights the crucial role of regulatory oversight in ensuring sustainability by balancing cost recovery with service affordability. While the study contributes valuable evidence on the drivers of financial performance, it does not assess how these factors jointly interact over time using panel data, a gap that the present study seeks to address.

Mawia et al. (2021) explored the factors that determine the financial health of Kenya's regulated water service providers. This study used a quantitative research methodology to analyze the impact of water price, infrastructure funding, utility efficiency, and subsidies on the long-term viability of Kenya's water service providers. A questionnaire was used to gather data from Kenyan water companies on water pricing models, infrastructure funding methods, utility efficiency initiatives, grants received, and financial performance metrics. The study utilized regression analysis and statistical methods to analyze data and determine correlations between variables, revealing a correlation between water prices and long-term economic viability. The study found that investing in infrastructure and utility efficiency boosts long-term profitability by saving money and boosting profits. However, it found conflicting results on the impact of subsidies on financial viability as the subsidies only help if they go to the right places and are used efficiently. The integration of qualitative insights added contextual depth by validating quantitative findings. However, its cross-sectional design constrains the ability to observe performance trends over time.

Research by Akinyi and Odundo (2018) on the factors impacting the financial sustainability of public water utilities in Kenya through revenue generation was conducted utilizing a case study methodology of Homa Bay Water and Sewerage Company. The researchers conducted interviews with utility employees and analyzed financial data to investigate how components of revenue production, such as water price, impact the utility's potential to remain financially viable in the long run. According to the findings of the study, the financial viability of the utility was greatly impacted by water pricing, in addition to other criteria including the number of customer connections and the reduction in non-revenue water. However, the case study’s narrow scope limits generalizability across utilities of varying size and governance structures.

Fuente et al. (2021) assessed the performance of tariffs with a focus on Nairobi City Water and Sewerage Company. The researchers made used a tariff simulation model on billing records from utility. The simulations described in this study offer a number of new perspectives on Nairobi's different tariff structures as well as on how to construct and assess water and sanitation tariffs more generally in low- and middle-income nations. The findings of the study were that uniform price tariff, which is a straightforward tariff with a uniform volumetric price, outperforms the increasing block tariff alternatives in every performance indicator analyzed. A uniform price tariff was simple for utilities to manage, simple for customers to comprehend, and delivered a clearer signal to customers about the cost of providing water and sanitation services. However, a uniform price tariff lacks the efficiency-promoting qualities. Tariff effectiveness depends not only on design but also on institutional efficiency, enforcement mechanisms, and customer income diversity factors that a simulation model may not fully capture.

Research on addressing the social repercussions of tariffs for water supply and sanitation was carried out by Leflaive and Hjort (2020). Although Kenya is not the primary focus of the study, it does offer some valuable insights into the broader consequences of water pricing on social fairness and financial sustainability. The researchers investigated several pricing systems to determine their effects on a variety of factors, including social inclusion, accessibility, and affordability. The study underlined the necessity for customized pricing structures to provide affordability for households with low incomes while preserving financial viability for water service providers. Andrés et al. (2021) argue, equitable tariff frameworks must be grounded in operational realities, linking pricing design with measurable indicators such as cost recovery, non-revenue water, and staff efficiency. Thus, while Leflaive and Hjort highlight critical social considerations, their work does not empirically assess the financial implications of tariffs.

To ensure the long-term viability of rural water systems, Miller et al. (2019) conducted a systematic study by examining the effectiveness of external support programs in enhancing sustainability of rural drinking water service. The research does not just concentrate on water rates; rather, it investigates the wider elements that influence the financial viability of rural water service providers. The researchers looked into a variety of outside assistance programs that were designed to improve long-term viability. Even though the research only found a small number of studies that directly addressed the role of tariffs, it highlighted the significance of cost recovery mechanisms, such as the design of tariffs and various collection strategies, in guaranteeing a water system's continued viability. Miller et al. provide a framework for understanding the interplay between financial and institutional factors, their analysis does not empirically evaluate the relationship between tariff structure, operational efficiency, and financial viability at the utility level.

Mohanty and Rout (2023) conducted a study assessing financial sustainability of rural water supply, an analysis of cost recovery, revenue collection, and efficiency. The research employed financial data from rural water delivery programs in Odisha, India; nonetheless, the findings have the potential to apply to the situation in Kenya. The researchers examined factors such as cost recovery, the efficiency of revenue collection, and operational efficiency as potential predictors of a company's capacity to remain financially viable. The relevance of water tariffs to income creation is acknowledged, even though the research does not focus directly on water rates. According to the results, it is necessary to have effective revenue collection and cost recovery procedures, as well as proper tariff design, to guarantee the continued sustainability of the rural water supply industry's finances. The study however does not address how low tariffs contribute to low cost coverage and hence low service provision by utilities.

The research was carried out by Lekaldero, Ndegwa, and Omanwa (2022) to investigate the impact that community involvement has on the long-term financial viability of community conservation areas in Northern Kenya. The study does not directly address water pricing; nevertheless, it does give insights into the role that community involvement plays in ensuring financial sustainability. Interviews, questionnaires, and statistical analysis of financial data were some of the study methodologies that were utilized by the researchers. According to the findings of the study, greater levels of community involvement positively affected the financial viability of conservation organizations by contributing to the development of additional cash. This study underscores the need for community engagement and income creation for financial sustainability in the larger context of water management; nevertheless, it is not directly applicable to water service providers. While the study highlights the importance of participatory management, it does not assess how operational or financial variables such as tariff setting, cost recovery, or personnel expenditure interact to influence viability.

Otieno and Miroga (2022) conducted research to determine how the incorporation of public-private partnerships influences the long-term financial viability of Nzoia Water Services Projects in Kenya. Although the study does not just concentrate on water rates, it does help our understanding of the elements that influence the viability of a company's. The researchers employed a descriptive survey approach and data was collected through questionnaire. According to the findings of the study, public-private partnerships may have a beneficial effect on the financial sustainability of an organization by increasing revenue collection, reducing costs, and developing infrastructure. The study's single-case design limits the generalizability of its conclusions across Kenya's diverse regulated utilities, and it does not empirically analyze how PPPs interact with other determinants such as tariff levels, non-revenue water, or personnel expenditure

Fraga and Alves (2025) investigated how subsidies embedded in water tariff structures affect affordability in low-income communities in Brazil's Federal District. Using household survey microdata combined with tariff and consumption records, the study revealed disparities in water use, with poorer households consuming an average of 108 liters per capita daily compared to 399 liters in wealthier areas. Despite subsidies for households consuming less, the distribution was found to be regressive, as higher-income consumers captured a larger share of benefits. Notably, almost a quarter of families in the lowest-income areas still spent more than 3% of their income on basic water consumption, highlighting affordability challenges. The study also showed that women-headed households with children were disproportionately vulnerable to water poverty. While the findings affirm that tariff subsidies can reduce costs for some groups, they emphasize that poorly designed subsidy mechanisms may undermine both equity and financial viability.

A study by Arellano, Ramírez, Arias, and Benalcázar (2024) examined the challenges of implementing water tariffs in Ecuador, drawing on data from 45 towns across urban and rural areas. Using regression analysis, the study assessed the relationship between population size, household water consumption, and tariff structures. The study found that population size had very little influence on how basic water consumption limits were set, explaining only about 10% of the variation. This highlighted that tariff frameworks often failed to reflect actual operational and maintenance costs, undermining cost recovery and long-term financial sustainability. The researchers further observed that small and medium-sized towns struggled with billing inefficiencies and delayed payments, while larger towns benefited from stronger enforcement mechanisms. The study concluded that tariff implementation is not merely a technical process but is strongly shaped by political dynamics, echoing broader evidence that governance weaknesses frequently undermine financial sustainability in water utilities.

A study by Acen, Olyanga, and Muhire (2025) examined how water tariff structures influence access to clean water in Lira City, Uganda. Using a mixed-method approach combining household surveys, focus group discussions, and key informant interviews, the study found that affordability of water tariffs was a critical determinant of access. While a majority of households perceived current tariffs as manageable, a substantial share particularly among low-income groups struggled to meet water expenses, often resorting to unsafe alternative sources. The findings further indicated that households were willing to pay higher tariffs if this guaranteed reliable and better-quality water services, highlighting the importance of linking tariff adjustments to tangible service improvements. The authors concluded that targeted subsidies, transparent regulatory oversight, and community involvement in tariff-setting are essential strategies to ensure both affordability and financial sustainability in Uganda's urban water supply systems.

Aiyetan (2025) conducted a survey-based study of municipal stakeholders in South Africa to examine barriers to sustainable and resilient water infrastructure. The study utilised a survey-based approach and quantitative data was collected and analysed. The study found that municipalities struggled with limited revenue collection due to poor billing systems, low water tariff recovery rates, and restricted access to external funding. These challenges resulted in chronic underinvestment and delays in infrastructure development. In addition, the study revealed that political interference in tariff-related budgeting often diverted resources away from priority needs, further undermining service delivery. The study concluded that strengthening cost-reflective tariffs, improving collection efficiency, and enhancing financial oversight are critical to ensuring both affordability and long-term infrastructure sustainability in South Africa's water sector. The study's South African context limits its generalizability to Kenya's regulated water utilities, which operate under distinct regulatory frameworks and performance benchmarks. Building on these findings, the present study employs panel data

analysis to evaluate how tariff structures, alongside non-revenue water and personnel expenditure, jointly influence the financial viability of Kenya's water service providers.

2.3.2 Non-revenue water and financial viability

Non-revenue water refers to the difference between the total volume of water produced and the amount that is billed to consumers. It represents water losses that occur due to physical leaks as well as water that is used but not recorded or charged to consumers or a combination of both (Wiedilaksono et al., 2024). A study by Ernest Ngolo and Kidere (2023), assessed strategies employed by water companies to reduce non-revenue water. The study adopted a mixed methods research design, gathering data through questionnaires administered to a sample of 61 water companies. The study's results validated that the obstacles to the effective execution of strategies to reduce NRW, as disclosed by the participants, encompassed diverse aspects. These hindrances encompassed human resource-related concerns, such as a lack of employee dedication, policy-related issues within the organization, including the absence of policies and guidelines, financial limitations, and structural challenges within the organization. Furthermore, technological factors, operational difficulties, and managerial or governance-related matters were also highlighted as drivers for NRW reduction by water companies. The research identified qualitative challenges that provide important context for understanding non-revenue water management.

A study conducted in Mwanza, Tanzania, a city in sub-Saharan Africa that is rapidly expanding, assessed hoe non-revenue water is managed (Shushu et al., 2021). The study investigated significance of optimizing PRV (Pressure Reducing Valve) systems. The study utilised a computational simulation model becomes in projecting future system states. While it's evident that elevated pressures in the system were primarily responsible for significant non-revenue physical water losses due to leaks and pipe bursts, the study attributed some of the losses to the existing network topology. The findings demonstrated that integrating pressure

reduction strategies with a modification of the network topology proved highly efficient in reducing NRW within the unplanned water system. Optimization of pressure reducing valves was found to be a crucial component for effectively curbing water losses throughout the network.

Sekyere et al., (2020) conducted a techno-economic evaluation of non-revenue water of the Ghana Water Company Limited, focusing on the Eastern Regin. The research used multiple regression analysis for calculating economies of scale to assess the dynamics of NRW) The analysis utilized data collected from the headquarters GWCL, including the period from January 2015 to June 2019. The findings of the study indicate that the average NRW for the specified time frame was 40.3%, surpassing the 25% benchmark established by the World Bank for countries in the developing stage. Furthermore, it has been determined that there exists a rather inelastic correlation between NRW and total revenue. While the study offers insights into the economic implications of NRW, its focused on a single utility and regional context limits generalization to other regulated utilities.

Yi et al., (2017) evaluated NRW in Mandalay City in Myanmar with a view of assess the management of viable water supply systems. The research was conducted through administration of questionnaires to employees of the water utility (134) and households (283). The findings show that causes on high rates of NRW were: 1) a system characterized by significantly reduced pressure levels; 2) repairs that exhibit substandard quality; 3) absence of routine maintenance practices; 4) inadequate knowledge among employees; 5) limited understanding of the concept of NRW; 6) weak customer relationships; 7) unwillingness of water users to actively engage in water losses management. The study pointed out that NRW poses a significant challenge to the effective and sustainable management of the water supply system in the city of Mandalay. The research focused on a single urban context and descriptive design may have limited its ability to quantify the financial impact of NRW on cost recovery.

A study focusing on the improvement of financial sustainability in urban water supply systems in Bhutan was conducted by Pradhan, (2023) specifically through a case study of Thimphu Thromde (Municipality). Financial data pertaining to the water sector of municipalities in Bhutan was gathered from several sources in order to acquire a comprehensive understanding of their overall financial performance. The findings of the study revealed that water price was slightly sufficient to generate revenue that covered the basic operation and maintenance expenditures. Furthermore, the study pointed out that a significant amount of income is lost as a result of high levels of NRW.

Santos (2024) investigated the relationship between NRW and the financial performance of water utilities in Portugal. Using panel data from 10 utility companies between 2017 and 2021, the study applied both ordinary least squares regression to test the impact of unbilled water and losses on profit margins. The analysis revealed a consistent and statistically significant negative association, with a one-unit increase in unbilled water linked to a decline in profit margins. The findings further showed that although water losses themselves were not always significant in the regression, the broader results emphasized that NRW poses a direct threat to financial viability of water companies. The study concluded that reducing NRW through is essential to safeguard the financial viability of utilities, particularly in publicly owned systems.

Bandari and Sadhukhan (2023) assessed the efficiency of NRW reduction in improving water supply performance across 55 Indian metropolitan cities. Using an input-oriented data envelopment analysis model with NRW as the input and cost recovery and per capita supply as outputs, the study examined how managing water losses influences financial sustainability. The results showed that majority of the cities could reduce NRW levels by more than half while simultaneously improving cost recovery. Furthermore, most cities surpassed the service benchmark of 135 litres per capita per day once NRW was reduced. The findings suggest that

reducing NRW is a more effective strategy for addressing water crises than augmenting new sources, as it directly enhances both revenue generation and service efficiency. The study concluded that utilities must prioritize NRW management to achieve financial viability and operational resilience.

See and Ma (2018) investigated the impact of NRW on the productivity of Malaysia's water services industry. Using panel data from 1999 to 2012, the study applied a Global Malmquist-Luenberger (GML) productivity index that incorporated NRW as an undesirable output. The analysis revealed that the industry experienced an average annual decline in total factor productivity, largely driven by technological regression rather than efficiency changes. The study also found no significant difference in performance across public, corporatised, or privately managed utilities, suggesting that ownership structure alone did not determine outcomes. The authors concluded that addressing NRW through infrastructure rehabilitation, district metering zones, and stronger regulatory incentives is essential to improving financial sustainability and ensuring reliable service delivery in Malaysia.

Farok (2016) conducted a case study on NRW management within the Dhaka Water Supply and Sewerage Authority in Bangladesh. Using surveys and secondary performance data, the study revealed that more than half of water produced was lost through technical leakages, illegal connections, inaccurate metering, and weak billing systems. The findings showed that these commercial and technical losses significantly reduced revenue collection. The study emphasized that governance weaknesses, corruption in revenue collection, and lack of preventive maintenance worsened NRW challenges, undermining both financial viability and service reliability.

Fagundes, Marques, and Malheiros (2024) analyzed the impact of Brazil's new water loss reduction goals on service efficiency and affordability. Using data from 4,883 utilities reported to the National Sanitation Information System (SNIS) for 2021, the study applied

scenario modelling to estimate potential revenue recovery from apparent loss reduction and cost savings from reduced physical losses. The results showed that reducing water losses could save up to 16.6% of national consumption volumes by 2034, generating net benefits of more than USD 5.5 billion. However, the findings also highlighted limitations: several utilities, especially smaller ones with low tariffs and limited economies of scale, might spend more on NRW programs than they save, undermining financial benefits. The study concluded that while efficiency gains from NRW reduction can enhance affordability and service expansion, implementation must account for local cost structures and ensure targeted support for vulnerable families.

2.3.3 Personnel costs and financial viability

The researchers Juma, Moguche, and Kanyiri (2022) carried out a study on relationship between staff engagement and operational performance among water utilities in Meru County. To evaluate the levels of staff engagement and operational effectiveness of water service providers, the research project used a descriptive research design. The findings indicated a significant and positive linear relationship between employee engagement and operational efficiency. However, the study did not directly assess the influence that staff expenses have on a company's capacity to remain financially viable. The research did not extend the analysis to assess how personnel expenditures influence the broader financial viability of utilities. Integrating financial indicators such as staff cost ratios and O&M cost coverage would have provided a more comprehensive understanding of how human resource efficiency translates into financial viability.

A study on the evaluation of the performance of water supply systems from an institutional perspective was conducted by Mishra, (2019), using mixed methods approach. The examination of institutional performance involved assessing many factors, including the performance index, organizational establishment, staff productivity index, capability of staff,

and the execution status of the water safety plan. The performance score was determined to be 70%, suggesting that the system was not operating properly. The staff productivity index was 36.53, indicating a lower level of employee productivity, which further indicated need for more capacity development of employees. This study reinforced the importance of human resource capacity in achieving operational excellence, which this research extends by examining how personnel expenditure and efficiency jointly influence financial viability across regulated WSPs in Kenya.

Atheru and Gichohi (2025) investigated the financial sustainability implications of payroll non-compliance in Meru County Government, Kenya, using audit data for the period 2021–2024. Employing a quantitative survey design and document analysis of Auditor-General reports, the study revealed persistent breaches of the Public Finance Management Act (2012), which caps personnel costs at 35% of total revenue. Meru County exceeded this limit consistently. The findings showed that irregular recruitment practices, unauthorized allowances, and payments without valid documentation significantly inflated the wage bill, reducing funds available for development expenditure. The study concluded that high personnel costs directly undermined financial sustainability by increasing recurrent spending at the expense of long-term investments. The study was conducted in a devolved government context and the findings provides relevant insights for water utilities where personnel costs similarly represent a major component of operational expenses.

Abdi (2024) conducted a qualitative review of wage bill management in Kenya's public sector, drawing on government reports, international institutional publications, and academic studies from 2014 to 2024. The study highlighted that personnel expenditure remains one of the largest fiscal pressures, with the wage bill consuming over 43% of government revenue in 2024, surpassing the internationally recommended ceiling of 35%. The review attributed this unsustainable growth to rapid public sector expansion after devolution, wage inflation driven

by harmonization and union negotiations, and inefficiencies in payroll management such as ghost workers and fraudulent payments. The study concluded that unless personnel costs are strategically managed through reforms such as workforce rationalization, transparent payroll systems, and linking wage growth to productivity, the rising wage bill erodes fiscal sustainability. The study focused on the public sector and its findings were relevant to water service providers.

Benjamin et al., (2017) evaluated the relationship between compensation targets and corporate performance. The study focuses on examining the distribution of reported performance in relation to incentive goals, with the aim of determining if performance clusters exist. The study utilizes panel data that encompasses detailed information about the performance objectives used in both equity and non-equity-based awards given by 974 businesses. The findings show that companies that narrowly surpass their Earnings Per Share (EPS) targets exhibit increased unusual accruals and reduced Research and Development costs. Similarly, companies that narrowly surpass their profit objectives tend to have decreased selling and administrative expenses. Although the study was conducted in a corporate environment, it offers critical insights for the water services sector.

Tarigan et al., (2022) conducted research on the relationship between total reward practices, employee satisfaction, and productivity in relation to organizational financial outcomes: A study on Indonesian generation Z workers. The study was undertaken on 40 companies in the service sector. The findings of this study confirm that the implementation of a total reward systems has a beneficial impact on job satisfaction, and employee productivity. In addition, Generation Z isn't easily pleased by money alone; they care more about being able to do things for themselves than about money. While the findings enrich the understanding of how reward structures shape employee behavior, they do not address how personnel costs and compensation structures affect the overall financial viability of organizations.

Brettenny and Sharp (2016) evaluated the efficiency of 88 urban and rural municipal water service authorities in South Africa using a data envelopment analysis (DEA) model. The study used operating expenditure as the main input variable, which included personnel-related costs, and outputs such as system input volume and households served. The findings showed that many municipalities could reduce their resource use by over 35% while maintaining current service levels, highlighting the financial risks of high personnel expenditure relative to output. The authors concluded that poor management of operating and staff costs undermined financial sustainability. The study did not examine how specific expenditure categories, such as personnel costs, directly affect financial viability. Moreover, its South African context and cross-sectional DEA approach limit the transferability of results to Kenya's regulated utilities, which operate under distinct governance and regulatory frameworks. This study seeks to build on these insights by empirically analyzing how personnel expenditure influences the financial viability of Kenya's water service providers using panel data.

A study by Puka et al. (2019) examined the influence of employee remuneration on performance in Kakamega County Government. A correlational research design was applied, targeting 242 respondents selected from different departments within Kakamega County Government. The study's results demonstrated a substantial, positive, and linear relationship between employee remuneration and employee performance, with a p-value below 0.05. The study findings indicated that employee remuneration and staff productivity was had a positive relationship. This suggests that an increase in employee salary would lead to a corresponding improvement in employee job performance. The study did not focus on the broader fiscal implications of rising wage expenditures on institutional financial viability.

Tarigan et al. (2022) examined the link between compensation and the financial performance of firms listed on the Johannesburg Stock Exchange. The strategy employed was quantitative research to examine the relationship between performance-based compensation

and the overall performance of firms. The research conducted has determined that the compensation strategies implemented for executive directors in the consumer goods and services sector in South Africa appear to be influenced by the company's stock price. Oluwafemi et al. (2020) investigated the effect of employee compensation on the financial performance of manufacturing firms in Nigeria. The study employed a non-experimental research design, using data from 2009 to 2018 obtained from the annual reports and financial statements of selected manufacturing companies. Findings revealed a statistically significant relationship between employee salaries, post-employment benefits, and profit after tax among the firms examined. Notably, the analysis did not reveal a significant association between staff costs and profit.

Kim & Jang, (2020) conducted an assessment of the impact of enhanced employee remuneration on firm performance, focusing on the restaurant sector for Publicly Traded Restaurants Listed under (North American Industry Classification System) NAICS. The present study utilized yearly data obtained from publicly traded restaurants that were classified under the NAICS codes 722511. The data covered the time period spanning from 1995 to 2018. For the purpose of study, a dataset consisting of 386 panel observations at the firm-level was utilized, covering a total of 58 firms. The findings of this study indicate that the increase in staff remuneration has a positive impact in the short term, but it exerts a negative influence on the long-term growth of revenue in the restaurant industry. These findings suggest that increasing employee compensation may lead to a boost in restaurant revenue growth in the short term, possibly within a one-year timeframe.

Sachs, Ewinyu, and Shedi (2024) examined long-term trends in South Africa’s government wage bill using payroll data from 1997 to 2021, focusing on compensation patterns in core public services such as healthcare, education, and criminal justice. The study showed that while employment levels in these essential services expanded during the 2000s, wage

growth placed increasing pressure on public finances. Personnel expenditure accounted for more than 78% of government payroll by 2021, with compressed salary structures reducing inequality between higher- and lower-paid workers but creating fiscal stress. The research indicated that blunt measures to cut wage bills often undermine morale and service delivery. The findings underscore how high personnel expenditure, if not properly managed, can weaken financial viability and reduce the quality of service delivery.

A study by Mahssouni et al., (2022) evaluated the impact of employee compensation, capacity development, and financial performance amidst the COVID-19 pandemic. The researcher sampled 103 pharmaceutical enterprises based in Belgium, whose financial records were made publicly available in the Bureau Van Djik database from 2012 to 2021 and panel data analysis was utilised. The findings indicate that the financial performance was significantly and adversely affected by the COVID-19 epidemic. The success of a firm can be explained by considering human resource elements such as staff salary and training. The study did not explicitly isolate the effects of personnel costs on operational cost coverage or financial viability. This study extends this analysis by exploring how personnel expenditure, as a component of operating costs, influences financial sustainability within regulated water service providers in Kenya.

2.4 Summary and Knowledge Gap

Numerous studies examined the factors influencing the financial health of water service providers in Kenya. These factors include water pricing, infrastructure funding, utility efficiency, and subsidies, with government regulation playing a moderating role. Studies emphasized the importance of revenue generation through pricing and customer connections, as well as the benefits of external support programs, community involvement, and public-private partnerships in enhancing financial sustainability.

Studies investigated strategies to reduce NRW in different regions. Common obstacles include human resource issues, policy gaps, financial constraints, and structural challenges. Optimizing pressure reducing valve (PRV) systems and addressing network topology have been emphasized as effective measures. Causes of NRW include reduced pressure, substandard repairs, and weak customer relationships. While water prices may cover basic costs in some cases, high NRW levels lead to significant income losses, highlighting the importance of addressing this issue for financial sustainability. Several studies examined the relationship between employee engagement, compensation, and organizational performance. The studies found a positive association between employee engagement and operational efficiency in water service providers. Deficiencies in system operation and staff productivity were noted in institutional evaluations of water supply systems. Studies also highlighted the effects of compensation targets on corporate performance, with implications for financial outcomes.

2.5 Conceptual Framework

A conceptual framework provides a coherent arrangement of interconnected concepts that facilitates the creation of a graphical representation or visual illustration of the interrelationships among ideas in research. This practice enables the researcher to provide a more precise context for the matter under investigation and to clarify their intended definitions of certain terminology. The analysis focused on three independent factors: water tariff, non-revenue water, and personnel expenditure. The dependent variable of this research study was financial viability. The conceptual framework is as presented in Figure 1.

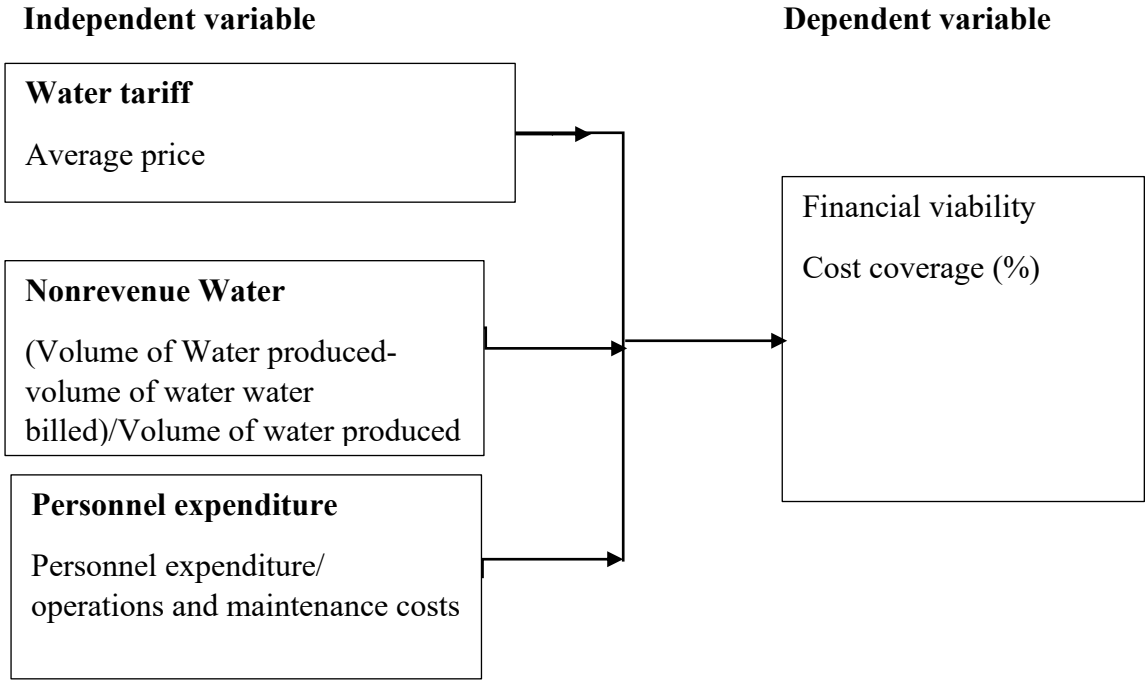

FIGURE 1 Conceptual Framework

2.6 Measurement of Study Variables

Operationalizing research variables involves precisely defining them into quantifiable elements, enabling their empirical and quantitative assessment. Operationalizing the study variables was crucial as it enabled the researcher to quantitatively measure the variables and assess the proposed hypotheses. Table 1 presents the operationalisation of the variables.

Type	Variable	Measurement	Variable Description
Dependant	**Financial viability**	Total operating Revenues/Total operating expenditures	The ability of a water company to meet operational and maintenance costs
Independent	**Water tariff**	Billing in Ksh/Billing M3	Average price of water
	Nonrevenue Water	Volume of Water produced-volume of water water billed/Volume of water water produced	Water lost due to technical and commercial losses

Type	Variable	Measurement	Variable Description
	Personnel expenditure as a percentage of operations and maintenance costs	Personnel expenditure/ operations and maintenance costs	Measure of the proportion of personnel expenditure that comprises of total operational costs

TABLE 1 Operationalization of Study Variables

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter provides a description of the processes that was employed to conduct the study. The chapter provides a description of its research design, target population, sampling processes, data collection methodologies, instrument validity and reliability, as well as data processing and analysis.

3.2 Research Design

A research design entails the arrangement of various factors necessary for the collection and analysis of data. As asserted by Cooper and Schindler (2014), the research design plays a pivotal role in addressing key aspects such as the data collection methods, the selection of appropriate sampling techniques and tools, and how to manage constraints related to time and costs. For this particular study, descriptive research design was used due to its suitability as it describes and summarizes existing data to gain insights into a particular population.

3.3 Target Population

A population is a full group of people, instances, or objects that have certain common observable traits (Mugenda & Mugenda, 2003). The study population for this research consisted of 89 public water companies in Kenya under WASREB as of 2023. The data is available in the Impact Reports: Performance Reports of Kenya's Water Services Sector published on the WASREB website from 2016 to 2023.

3.4 Sampling and Sampling Procedure

As stated by Kull (2013), sampling refers to the systematic procedure of selecting and assessing a limited subset of individuals, subjects, or occurrences with the aim of gaining insights into

the broader population from which they were derived. Given the relatively small population size, a census approach was used. In cases where the sample size is small, often consisting of 200 individuals or less, it is common pracstice to utilize the whole population for analysis (Asenahabi & Ikoha, 2023). Since the entire population is measured, there is no sampling error in statistics derived from a census, ensuring greater accuracy and reliability in the findings (Lohr, 2022). A census approach was used since data for all regulated WSPs were available.

3.5 Data Collection Procedure

Secondary data was utilized in the research, sourced from the 89 public water companies in Kenya companies licenced by WASREB. The data spanned from 2016 to 2023, providing nine period and enabling the creation of a panel dataset. The study covered the period from 2016 to 2023, as the Water Act 2016 was operationalised following a revision of the Water Act 2002, which brought major changes to the water and sanitation sector informed by the Constitution of Kenya 2010. A data collection sheet in Microsoft Excel was used in this study as the data collection tool. There were three independent variables (water tariff, non-revenue water, and personnel expenditure), and the dependent variable was financial viability. All of the public regulated water service providers in Kenya were included. Data were sourced from impact reports available on the WASREB website, which track operational and financial data of the water companies. Data accuracy was conducted through a cleaning process that involved checking for completeness, consistency, and outliers. Data was validated through cross-checking annual performance reports and removing outliers. Missing data was addressed by applying mean substitution.

3.6 Data Processing and Analysis

The data was analysed using descriptive and inferential statistics. The presentation and organization of data using descriptive statistics included central measurements, dispersion, and central measure patterns. The central tendencies were assessed using the mean, median,

maximum, and minimum, while the dispersion was assessed using the standard deviation, kurtosis, and skewness. In addition, correlation analysis and multiple regression analysis were used to analyze the data gathered. The Pearson-pairwise correlation coefficient was used to quantify the level of correlation between the model variables. The range of a linear connection between two variables in correlation was expressed by the Pearson-pairwise correlation coefficient, and it could be anywhere between +1 and -1.

The research hypotheses presented in this study constituted the basis for the hypothesis testing that took place. It was determined whether or not to reject each hypothesis. Using a 95% confidence interval, if the p-value had a value of less than 0.05, then the null hypothesis was rejected and the alternative hypothesis accepted. STATA was used for data analysis since it is a useful tool with numerous features to transform data based on requirements. The findings of the data analysis were displayed in tables.

3.7 Analytical Model

The following statistical regression model, developed based on the study objectives, was used to determine the relationship between the independent and dependent variables in this investigation. The variables' regression model had the following structure:

$$Y = \beta_0 + \beta_1 X1 + \beta_2 X2 + \beta_3 X3 + \varepsilon \quad (3.1)$$

Where:

Y = Financial viability of water service providers

X1 = Water tariff

X2= Non-revenue water

X3 = Personnel expenditure as a percentage of operations and maintenance costs

β_i = Beta$_2$coefficients (i = 0, 1,2,3)

ε = Error term

The research used a 95% confidence interval to test the hypotheses. For a given test, if a p-value was less than 0.05, the null hypothesis was rejected in favor of the alternative hypothesis. STATA was used for data analysis, and the findings were displayed in tables.

3.8 Data Diagnostic Analysis Tests

In this study, conditional diagnostics and statistical tests were used. Investigations were conducted into multicollinearity, autocorrelation, and heteroscedasticity.

3.8.1 Multicollinearity

The Variance Inflation Factor (VIF) and Tolerance tests are commonly applied to assess whether variables exhibit collinearity or multicollinearity (Kodongo, Natto, & Biekpe, 2015). A tolerance value below 0.2 and a VIF greater than 10 indicate the presence of multicollinearity (O'Brien, 2007). In multiple regression, multicollinearity arises when two or more predictor variables are highly correlated (Cooper & Schindler, 2011). This linear dependence among explanatory variables reduces the reliability of the regression model, as coefficient estimates become unstable and sensitive to small changes in the data (Kothari & Garg, 2014). Multicollinearity inflates the standard errors of coefficients, making it harder to isolate the effect of individual predictors. As Cooper and Schindler (2011) point out, small coefficient values and insignificant t-statistics under such conditions suggest little or no meaningful relationship between the independent and dependent variables.

3.8.2 Autocorrelation Test

Autocorrelation refers to the occurrence of serial correlation within sample data, a situation that ideally should not be present (Dźwigoł, 2019). In this study, wooldridge test was applied for detecting autocorrelation in panel data models. It evaluates the null hypothesis of no first-order serial correlation in the idiosyncratic error terms of a panel regression. A significant test statistic ($p < 0.05$) indicates the presence of autocorrelation, which violates classical regression

assumptions and may lead to biased standard errors and inefficient estimates (Wooldridge, 2010).

3.8.3 Heteroscedasticity

Contrary to situations where Ordinary Least Squares, or OLS, assumes that the variance of the error term is constant (homoscedasticity), heteroscedasticity occurs when the variance of the dependent variable varies across the data. Due to the fact that many techniques for performing regression analysis rely on the assumption of equal variance, heteroscedasticity makes analysis more difficult (Park, 2015). Using Stata 13, the regression residuals were checked for normality and heteroscedasticity.

3.9 Ethical Considerations in the Research Study

Approval to conduct the study was first obtained from the KCA University Scientific and Ethics Review Committee, after which a research clearance permit was granted by the National Commission for Science, Technology, and Innovation (NACOSTI). The study utilized secondary data obtained from publicly available sources, including WASREB Impact Reports, which were duly acknowledged and cited. Although no primary data involving human participants was collected, ethical standards were observed through the responsible use of data. All datasets were handled with confidentiality, stored in password-protected files, and accessed only by the researcher to ensure data integrity and security. The secondary data were used strictly for academic purposes in line with NACOSTI guidelines on ethical data handling. The research findings were disseminated in a workshop setting to promote knowledge sharing.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter is a crucial part of the study as it focuses on the transformation of collected data into meaningful insights. It provides the basis for examining the dataset in detail and identifying significant patterns, relationships, and trends. By applying appropriate analytical techniques and tools, the chapter seeks to present the findings. The analysis not only shows how the data is organized and interpreted but also generates insights that address the research objectives and support the subsequent discussion and conclusions. The study achieved a 100% response rate since it utilized secondary data from 89 regulated water service providers as captured in publicly available sources from WASREB impact reports.

4.2 Descriptive Results of Study Variables

Descriptive statistics refer to a set of techniques used to organize, compute, and present research data in a clear and meaningful manner. They provide a logical and efficient way of summarizing information, allowing for easier interpretation of key characteristics within a dataset (Vetter, 2017). The focus is on describing fundamental aspects such as averages, variability, and the general shape of the distribution. For this research, values including the mean, median, maximum, and minimum were produced with the use of STATA software (Version 16). Additional measures such as the standard deviation, skewness, and kurtosis were also computed. The mean represents the average of the dataset, taking into account every observation, while the median refers to the central point of the data set.

The variability of a dataset is often described using the standard deviation, which indicates how far individual values deviate from the mean; a small value suggests that the data points are concentrated around the average, while a larger value reflects greater dispersion

(Vetter, 2017). Beyond variability, the shape of the distribution can be assessed through skewness and kurtosis. Skewness measures the degree of asymmetry in the distribution, where positive skewness indicates a longer right tail and negative skewness reflects a longer left tail (Cooksey, 2020). Kurtosis, on the other hand, evaluates the sharpness of the distribution's peak and the weight of its tails, with high kurtosis pointing to heavier tails and more extreme observations compared to a normal curve. A distribution with negative skewness is characterized by a long left tail, meaning that most observations lie above the mean, while a few extreme negative returns pull the curve leftward (Neuberger & Payne, 2018). For the purpose of this study, the results are presented in Table 4.1.

Table 4.1 shows that the reported mean for financial viability (operating and maintenance (O&M) cost coverage) was 92.3%, with the highest at 157% and the lowest at 57.8%. O&M cost coverage was operationalized by the ratio of total operating revenues to total operating expenditure. The results indicate that on average, WSPs generate revenues sufficient to cover about 92.3% of their operating and maintenance expenditures. This implies that most utilities are unable to fully finance their recurrent costs from revenues, which raises concerns on financial viability and service reliability. The standard deviation of 24.7 shows a moderate variation across utilities, with some performing well above cost recovery while others remain far below.

The results in Table 4.1 also show that the mean tariff level was Ksh 82.6, with a minimum of Ksh 7 and a maximum of Ksh 297.5. Tariffs were operationalized as the average price of water billed per cubic meter across utilities. On average, therefore, customers paid about Ksh 82.6 per cubic meter, although there is wide variation as indicated by the standard deviation of 42.1. This large variation reflects the diversity in cost structures and subsidy levels across different utilities.

Table 4.1 further reports that the mean level of NRW was 43.5%, with the minimum being 12.3% and the maximum 78.6%. NRW was operationalized as the proportion of water produced but not billed to customers due to physical or commercial losses. This implies that, on average, nearly half of the water produced by utilities does not generate revenue. The standard deviation of 13 indicates moderate variability across WSPs, with some performing very efficiently while others suffer extremely high losses. The mean level of 43.5% remains well above the international benchmark of 25%, highlighting significant inefficiencies.

Table 2 shows that the mean personnel expenditure as a share of O&M costs was 42.2%, with a maximum of 91% and a minimum of 14%. This indicator was operationalized as the ratio between staff costs and total O&M costs. The reported standard deviation of 11 indicates that personnel expenditure varies across utilities but remains a significant component of operational costs. The average of 42.2% is relatively high compared to the 30 percent benchmark recommended by WASREB (2023), suggesting that many utilities may be overstaffed or inefficient in human resource deployment. High staff costs reduce the resources available for maintenance, rehabilitation, and system expansion.

```
. xtsum OandM WT NRW PE
```

Variable		Mean	Std. Dev.	Min	Max	Observations
OandM	overall	.9238618	.2475215	.0578853	1.570088	N = 714
	between		.2308869	.1780453	1.351347	n = 92
	within		.1424836	.3156305	1.6279	T-bar = 7.76087
WT	overall	82.61715	42.12877	7.091732	297.561	N = 748
	between		37.25653	8.52341	252.4199	n = 92
	within		18.77448	6.664454	194.8115	T-bar = 8.13043
NRW	overall	.4350612	.1301927	.1237535	.7864883	N = 707
	between		.1148463	.1629883	.7342688	n = 92
	within		.0651315	.2077092	.6988906	T-bar = 7.68478
PE	overall	.4228702	.1161926	.14	.91	N = 738
	between		.0972479	.175	.6368661	n = 92
	within		.0699729	.1207994	.8749591	T-bar = 8.02174

FIGURE 2 Descriptive Statistics of Study Variables

4.3 Diagnostics Tests

Prior to estimating the regression model, it was necessary to verify that the core statistical assumptions underpinning the analysis were met. To achieve this, the study conducted several diagnostic tests, including normality, linearity, homoscedasticity, and multicollinearity checks. These tests provided assurance that the relationships specified in the model could be interpreted with confidence. Undertaking such diagnostics reduces the likelihood of biased estimates or misleading conclusions.

4.3.1 Multicollinearity

Multicollinearity was tested using the Variance Inflation Factor (VIF). This statistic measures how much the variance of a regression coefficient is affected by the presence of correlations among independent variables. When the VIF is high, it indicates strong overlap between predictors, which can increase standard errors and weaken the accuracy of coefficient estimates (Kim, 2019). A VIF exceeding 10 is typically viewed as an indication of severe multicollinearity, implying that the explanatory variables are highly linearly related. Figure 2 presents the findings.

```
. vif
```

Variable	VIF	1/VIF
WT	1.06	0.939721
PE	1.05	0.950967
NRW	1.01	0.987871
Mean VIF	1.04	

FIGURE 3 Multicollinearity Test

Table 3 reports an average VIF of 1.04, which falls well within the acceptable range of 1–10. This indicates that multicollinearity is not a concern in the sample data used for the study.

4.3.2 Autocorrelation test

The Wooldridge test for autocorrelation in panel data yielded an F-statistic of 0.026 with a p-value of 0.8734. Since the p-value exceeds the 0.05 threshold, the null hypothesis of no first-order autocorrelation is not rejected. This indicates that the panel data regression does not suffer from autocorrelation, and the independence of errors assumption is satisfied.

```
. xtserial OandM WT NRW PE

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,      69) =      0.026
           Prob > F =      0.8734
```

NB: H0: no first-order autocorrelation. 0.4328<0.05 thus reject Ho. Conc: there exists first-order autocorrelation.

4.3.3 Homoscedasticity

Heteroskedasticity occurs when error variances differ across observations, which is common in panel data where units may have distinct variance structures. Modified Wald test for groupwise heteroskedasticity was conducted to evaluates whether the variance of the residuals is the same across all cross-sectional units, with the null hypothesis specifying homoskedasticity. A significant result indicates heteroskedasticity, warranting the use of robust or cluster-robust standard errors for valid inference (Khosropour, 2017). The test yielded a p-value of 0.0000, leading to rejection of the null hypothesis. This result indicates the presence of heteroskedasticity across panels.

```
. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (89)  =    2.8e+31
Prob>chi2 =      0.0000
```

4.3.4 Regression analysis

The study employed panel regression analysis to examine the determinants of financial viability among regulated water service providers in Kenya. Based on the Hausman test, the fixed-effects model was found to be more appropriate than the random-effects model. The corresponding regression results are presented in Figure 3.

```
. xtreg OandM WT NRW PE

Random-effects GLS regression                   Number of obs     =         594
Group variable: WSP_ID                          Number of groups  =          89

R-sq:                                           Obs per group:
     within  = 0.0063                                         min =           1
     between = 0.2812                                         avg =         6.7
     overall = 0.1395                                         max =           9

                                                Wald chi2(3)      =       14.63
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =      0.0022
```

OandM	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
WT	.0003066	.0003672	0.83	0.404	-.0004132	.0010264
NRW	-.1457078	.0918436	-1.59	0.113	-.325718	.0343024
PE	.3245623	.0938942	3.46	0.001	.1405329	.5085916
_cons	.8110447	.0667995	12.14	0.000	.6801201	.9419694
sigma_u	.19884957					
sigma_e	.14223473					
rho	.66153448	(fraction of variance due to u_i)				

FIGURE 4 Regression Results

The regression results in Table 4.3 further show that water tariffs have a positive but insignificant effect on O&M cost coverage ($\beta = 0.0003$, $p = 0.404 > .05$). This suggests that, although higher tariffs may generate additional revenue, the effect is not statistically significant in this study. The results in show that personnel expenditure has a positive and significant effect on O&M cost coverage of water service providers in Kenya ($\beta = 0.3246$, $p = 0.001 < .05$). Statistically, this indicates that a unit increase in personnel expenditure is associated with a 32.46 percent increase in O&M cost coverage, holding other factors constant. However, this finding contradicts theoretical expectations, since higher staff costs increase total O&M expenditure and should ordinarily reduce cost coverage. The regression results also show that

non-revenue water has a negative but insignificant effect on O&M cost coverage ($\beta = -0.1457$, $p = 0.113 > .05$). This implies that higher levels of NRW are associated with lower O&M cost coverage, although the effect is not statistically significant. This aligns with theory, since water losses reduce revenue available to meet O&M obligations. The insignificance of the effect in this study could be explained by mitigating factors such as external subsidies, donor financing, or compensatory tariff adjustments that cushion the utilities from the full financial impact of NRW.

Based on the results in Figure 3, the fitted model is expressed as follows:

Financial Viability (O&M) cost coverage) =0.811+0.0003WT−0.146NRW+0.325PE∗

This model explains approximately 13.95 percent of the variation in financial viability among water service providers in Kenya, as indicated by the overall R-squared value of 0.1395.

4.4 Discussion of Results

The financial viability of WSPs in Kenya remains a central concern for regulator, policymakers, and sector stakeholders. Under the Water Act 2016 and the oversight of the Water Services Regulatory Board (WASREB), utilities are required to achieve and sustain operations and maintenance (O&M) cost coverage to ensure efficient service delivery and long-term sustainability. Achieving this benchmark is, however, influenced by multiple operational and institutional factors that determine whether WSPs can generate sufficient revenues to cover their recurrent expenditures.

The first objective of the study was to assess the effect of water tariff on the financial viability of regulated water service providers in Kenya. The regression results revealed that water tariffs had a positive but statistically insignificant effect on financial viability. Thus, this study fails to reject the null hypothesis, suggesting that while water tariffs had a positive effect, the relationship with financial viability was not statistically significant. This outcome is consistent with a Kenyan study by Mawia, Okech, and Kalunda (2021) who found that water

pricing, infrastructure financing, utility efficiency, and subsidies jointly explain financial sustainability of WSPs, with water pricing alone being insufficient. Their findings echo Vučijak et al. (2018), observed that in the Western Balkans, tariff reforms without efficiency improvements and infrastructure investment fail to deliver sustainability. Similarly, Monteiro et al. (2016) noted that in Mozambique, tariff increases had to be complemented by infrastructure investment to offset NRW losses and ensure cost recovery. At a broader scale, studies from Oman (Al-Shueili, 2014) and Portugal (Pinto & Marques, 2014) emphasize that cost-reflective tariffs are vital for long-term financial sustainability, but must be paired with subsidies and governance reforms to balance equity and access.

The insignificant statistical effect in the Kenyan case therefore does not diminish the importance of tariffs; instead, it highlights that tariffs alone cannot secure financial viability without complementary measures such as reducing NRW, improving billing efficiency, ensuring infrastructure financing, and applying targeted subsidies. This reinforces the argument that sustainable financial viability in the Kenyan water sector requires an integrated approach where water pricing plays a role but works jointly with other institutional and financial mechanisms.

The second objective of the study was to examine the effect of NRW on the financial viability of regulated WSPs in Kenya. The regression results revealed that NRW had a negative but statistically insignificant effect on financial viability. Thus, this study fails to reject the null hypothesis, indicating that although higher NRW reduces financial viability, the effect was not statistically significant in the present model. This finding is consistent with a study in Ghana where Appiah, Du, and Sarpong (2017) found a negative and significant association between NRW and both water sales and revenues, confirming that as NRW decreases, revenue increases and operating costs are contained. Similarly, in India, Mukherjee, et al (2015) observed that NRW in Bangalore diverted potential company revenues to private vendors and weakening

cost recovery of the utility. At the utility level, apparent-loss drivers unbilled authorized consumption, meter inaccuracies, and illegal connections are repeatedly linked to elevated NRW and diminished financial performance (Kiptala et al., 2019; Shilehwa & Gakuu, 2016). NRW rises with urban population (complexity/pressure effects) and falls with higher residential and private ownership. Tariffs and aggregate investment were not significant predictors of NRW, implying governance and targeting matter more than price levels for loss control (Souza et al., 2025). Board and management incentives, data systems, targeted capital and operational expenditure, and performance around NRW are likely to yield improvements in financial viability than tariff moves alone. The insignificant result in the current study therefore does not diminish the importance of NRW. The broader literature emphasizes that systematic NRW reduction is critical for long-term viability, and that WSPs must integrate technical, institutional, and financial strategies to bring NRW closer to the accepted benchmark of 25% or below.

The third objective of the study was to determine the effect of personnel expenditure (PE) on the financial viability of regulated WSPs in Kenya. Personnel expenditure shows a statistically significant effect on financial viability. This means changes in personnel expenditure are associated with meaningful changes in financial viability . Regression results indicated that, holding other factors constant, a unit increase in personnel expenditure is associated with a improvement in cost coverage. However, one possible explanation is that utilities with higher PE may simultaneously exhibit stronger institutional capacity, better-qualified staff, and more effective revenue collection systems, which offset the rising costs. These results are supported by a study of the Blantyre Water Board in Malawi revealed that staff efficiency was a major determinant of financial sustainability, with staffing ratios of 12–18 per 1,000 connections far above international best practice of ≤5, contributing to unsustainable costs and recurrent deficits (Kalulu & Hoko, 2010). Similarly, Miranti (2022)

found that Indonesian water utilities faced scale inefficiencies when staffing and O&M costs were misaligned, while productivity improved in cases where personnel resources were optimally allocated. In Kenya, Yagan (2014) and Sindani (2020) linked a rising public wage bill to fiscal imbalances and constrained public investment, demonstrating that unchecked personnel costs can undermine financial sustainability at both macroeconomic and sectoral levels.

Molinos-Senante and Sala-Garrido (2015) emphasized that in Chile, productivity improvements in privatized utilities were strongly tied to efficient labor use and human capital investment. In Belgium, Mahssouni et al. (2022) observed that employee compensation contributed positively to long-term financial performance, even when short-term costs increased. Likewise, Wanigasekara and Mendis (2021) reported a strong and positive relationship between employee productivity and firm profitability in Sri Lanka, reinforcing the importance of human capital efficiency as a driver of financial viability. Excessive or poorly managed personnel expenditure manifested in bloated staffing ratios or ghost workers risks undermining cost recovery, as noted in Malawi and in Kenya's broader wage bill debates (Okech & Lelegwe, 2015). On the other hand, strategic investment in personnel through fair compensation, training, and outsourcing of non-core functions enhances efficiency, boosts service delivery, and ultimately strengthens financial viability.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides an overview of the key results of the study and evaluates the extent to which the research objectives were achieved. It is organized into four main parts: a summary of findings, conclusions, policy-oriented recommendations, and suggestions for further research.

5.2 Summary of Key Findings

This section outlines the main findings of the study, structured around the specific research objectives. Each objective is discussed in turn, highlighting the core outcomes that emerged from the analysis.

5.2.1 Water tariffs

The study revealed that water tariffs had a positive but statistically insignificant effect on the financial viability of regulated WSPs in Kenya ($\beta = 0.0003$, $p = 0.404 > .05$). Although higher tariffs can generate more revenue, their impact was limited in this study. The insignificance may be attributed to delays in tariff approval, inefficiencies in billing and collection, and structural challenges in implementation. The findings are consistent with earlier studies that emphasize tariffs alone cannot guarantee financial sustainability unless complemented by efficiency improvements, infrastructure financing, and targeted subsidies (Mawia et al., 2021; Vučijak et al., 2018; Monteiro et al., 2016).

5.2.2 Non-revenue water

The regression analysis showed that NRW had a negative but statistically insignificant effect on financial viability ($\beta = –0.1457$, $p = 0.113 > .05$). This implies that higher levels of NRW reduce cost coverage, but the effect was not significant within the model. The insignificance can be explained by mitigating factors such as subsidies, donor support, or compensatory tariff

adjustments. Nonetheless, the finding aligns with global literature that identifies NRW as a critical barrier to cost recovery and financial sustainability (Appiah et al., 2017; Mukherjee et al., 2015). Persistent high NRW remains a challenge in Kenya, highlighting the need for targeted technical, operational, and institutional strategies.

5.2.3 Personnel expenditure

Personnel expenditure (PE) was found to have a positive and statistically significant effect on financial viability ($\beta = 0.3246$, $p = 0.001 < .05$). Statistically, this means a unit increase in PE is associated with a 32.46% increase in O&M cost coverage. While this contradicts conventional expectations that higher personnel costs reduce cost coverage, the finding suggests that utilities with higher PE may also benefit from stronger institutional capacity, skilled staff, and more efficient revenue collection systems, which offset rising wage costs. Supporting evidence from Malawi, Indonesia, and Sri Lanka underscores that staff efficiency, training, and productivity improvements can enhance financial viabillity (Kalulu & Hoko, 2010; Miranti, 2022; Wanigasekara & Mendis, 2021).

5.3 Conclusions

The study concludes that the financial viability of Kenyan WSPs is shaped by a combination of tariff structures, NRW management, and personnel expenditure. Tariffs, while important for revenue generation, are insufficient on their own to guarantee financial viability. NRW remains a persistent drain on revenues, highlighting the importance of technical and institutional reforms. Personnel expenditure emerges as a paradoxical but positive driver of viability, suggesting that investing in human capital may yield productivity gains that outweigh increased wage costs. Overall, financial viability in the Kenyan water sector requires an integrated approach that balances revenue generation, operational efficiency, and institutional capacity.

5.4 Recommendations

The study highlights the role of personnel expenditure, suggesting that resources allocated to staff can improve efficiency when properly managed. Therefore, WSPs should invest in training, performance management systems, and outsourcing of non-core functions to enhance productivity and ensure that personnel costs translate into improved service delivery and cost coverage. There is need for wage bill monitoring. WASREB should strengthen enforcement of benchmarks for personnel expenditure as a percentage of O&M, staff-to-connection ratios to minimize inefficiencies and prevent wage costs from undermining operational sustainability. By ensuring that personnel expenditure is aligned with efficiency and productivity, WSPs can improve cost recovery and long-term financial viability. Financial viability of WSPs cannot be achieved without strengthening operational systems. Utilities should prioritize the enhancement of billing and collection mechanisms to maximize tariff revenue realization. Addressing the persistent challenge of non-revenue water through targeted interventions such as active leak detection, timely replacement of aging pipelines, and stricter control of illegal connections are essential to reduce water losses and safeguard revenues.

5.5 Areas for Further Studies

Future research on governance and institutional reforms deserve closer examination, since regulatory frameworks, board practices, and accountability mechanisms significantly shape financial outcomes. More focused work on the interaction between subsidies, donor funding, and utility efficiency would be valuable, as these external resources often play a critical role in bridging revenue gaps, yet their effectiveness in fostering sustainable financing models remains underexplored.

5.6 Limitation of the Study

Like any empirical research, this study was subject to several limitations that should be acknowledged when interpreting the findings. First, the study relied on secondary panel data

from regulated water service providers in Kenya. While the data was obtained from credible regulatory sources, challenges such as missing values, reporting inconsistencies, and variations in data quality across utilities may have influenced the accuracy of the results. Second, the scope of analysis was limited to three explanatory variables water tariffs, non-revenue water, and personnel expenditure while other potential determinants of financial viability, such as governance structures, infrastructure financing, and subsidy allocation, were not directly included in the model.

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APPENDICES

Appendix I: Regulated Water Service providers

	Water service provider
1	Amatsi
2	Bomet
3	Busia
4	Chemususu
5	Eldama Ravine
6	Eldoret
7	Elwak
8	Embe
9	Embu
10	Garissa
11	Gatamathi
12	Gatanga
13	Gatundu
14	Githunguri
15	Gusii
16	Homabay
17	Imetha
18	Isiolo
19	Iten Tambach
20	Kahuti
21	Kakamega
22	Kapenguria
23	Kapsabet Nandi
24	Karuri
25	Kathiani
26	Kathita Kiirua
27	Kericho
28	Kiambere Mwingi
29	Kiambu
30	Kibwezi Makindu
31	Kikuyu
32	Kilifi Mariakani
33	Kirandich
34	Kirinyaga
35	Kisumu
36	Kitui
37	Kwale

38 Kyeni
39 Lamu
40 Limuru
41 Lodwar
42 Machakos
43 Malindi
44 Mandera
45 Matungulu Kangundo
46 Mavoko
47 Mbooni
48 Meru
49 Migori
50 Mombasa
51 Murang'a
52 Murang'a South
53 Murugi Mugumango
54 Mwala
55 Nairobi
56 Naivasha
57 Nakuru
58 Nakuru Rural
59 Namanga
60 Nanyuki
61 Narok
62 Naromoru
63 Ndaragwa
64 Ngagaka
65 Ngandori Nginda
66 Nithi
67 Nol Turesh Loitokitok
68 Nyahururu
69 Nyandarua
70 Nyasare
71 Nyeri
72 Nzoia
73 Ol Kalou
74 Olkejuado
75 Oloolaiser
76 Othaya Mukurweni
77 Ruiru-Juja
78 Samburu
79 Sibo

80 Tachasis
81 Tana
82 Tavevo
83 Tetu Aberdare
84 Thika
85 Tililbei
86 Tuuru
87 Wajir
88 Wote
89 Yatta

Appendix II: Data Collection Sheet

		Billing in Ksh	Billing M3	Volume of Water produced M3	Personnel expenditure in Ksh	Operations and maintenance costs Ksh	operating Revenue Ksh
	YEAR						
Water company 1	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
Water company 2	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
Water company 3	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						
Water company n	2016						
	2017						
	2018						
	2019						
	2020						
	2021						
	2022						
	2023						

Appendix III: NACOSTI

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KCA UNIVERSITY SCIENTIFIC AND ETHICS REVIEW COMMITTEE

REF: **KCAU/SERC/095** **Date: 5th May 2025**
TO: **FLORENCE M MUCHERU (21/00685)**

Dear Sir/Madam

RE: FINANCIAL VIABILITY AMONG REGULATED WATER SERVICE PROVIDERS IN KENYA

This is to inform you that KCA University Scientific Ethics Review Committee (KCAUSERC) has reviewed and approved your above research proposal. Your application approval number is ***KCAUSERC*SOB095**. The approval period is ***5TH May 2025 – 5th May, 2026.***
This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***KCAUSERC***.
iii. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to KCAU***SERC*** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to ***KCAUSERC*** within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to ***KCAUSERC***.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://research-portal.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely

Dr. Caroline Ntara
Chairperson
KCA University Scientific & Ethics Review Committee