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HOUSEHOLD AND GOVERNANCE FACTORS INFLUENCING SUSTAINED ACCESS TO PIPED WATER SERVICE FROM COMMUNITY-MANAGED SUPPLY IN NAKURU COUNTY, KENYA

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JULY, 2026

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DECLARATIONS

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DEDICATION

This work is dedicated to my family and the rural poor.

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ACKNOWLEDGMENT

With gratitude, I acknowledge the help of Almighty God throughout my study. I ascribe all glory to you.

I will never thank you enough, Dr. Nzengya Muasya and Prof. Grace Lorna. Your acumen in research is amazing. You encouraged me all through and worked tirelessly to ensure that I got it right; may the Almighty God replenish you.

To my wife and children, your unwavering support through this rigorous process is appreciated.

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ABSTRACT

Access to sustainable and safe water remains a significant challenge in many low- and middle-income countries, especially for rural and marginalized populations where centralized systems often fail to serve. Community-managed water systems have emerged as viable alternatives, especially in Kenya. The study aimed to analyze several factors affecting household sustained access to community-managed water systems, including household socio-economic status, livelihood use, water service convenience, water quality, and governance practices. Its specific objectives were; to analyze the influence of household socio-economic factors on sustained access to piped water from community-managed water supply, to assess the influence of access to water for livelihood on sustained access to piped water from community-managed water supply, to examine the influence of water service convenience on sustained access to piped water from community-managed water supply, to evaluate the influence of quality of water service on sustained access to piped water from community-managed water supply.to assess the moderating effect of governance practices on the relationship between household and governance factors and sustained access to piped water from community-managed water supply. The analysis was guided by capability theory, socio-technical systems theory, community-based natural resource management, and common pool resource theory, which provided a framework for understanding the factors affecting sustained access to water service. The research guided by pragmatism philosophy adopted a mixed-methods approach, combining quantitative surveys and qualitative interviews. The study sample comprised 135 respondents from a population of 696 for the quantitative surveys, and 60 informants for FGDs. Quantitative data analysis involved descriptive and logistic regression, while qualitative data evaluation involved thematic analysis. The study found that socio-economic status, water access for livelihood, water service convenience, and water quality significantly ($p \leq 0.05$ influenced household sustained access to community-managed water systems. Over and above that, water governance factors significantly moderated livestock keeping (OR = 1.79), availability of service (OR = 8.63), and water quality (OR = 2.41). The findings suggest that pro-poor subsidies and clearer governance frameworks are needed to improve the sustainability of community-managed water systems.

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ACRONYMS AND ABBREVIATIONS

AMCOW	African Ministers' Council on Water
CA	Capability Approach
CBNRM	Community-Managed Natural Resource Management
CMM	Community Management Model
CMWS	Community-Managed Water Service
CPR	Commons Pool Resource
CWCs	Community Water Committees
ESP	External Support Providers
FGD	Focus group discussion
IAD	Institutional Analysis and Development Framework
IR	Institute review
JMP	Joint monitoring program
KNBS	Kenya National Bureau of Statistics
LMIC	Low-middle- income countries
MDGs	Millennium Development Goals
NAWASSCO	Nakuru water and sanitation services company
NGCDF	National Government Constituency Development Fund
NGOs	Nongovernmental Organizations
OECD	Organization for Economic Co-operation and Development
PCA	Principal Component Analysis
RMSE	Root Mean Square Error
RWSN	Rural water supply network
SDG	Sustainable Development Goal

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SPSS	statistical package for the social science
SSA	Sub-Saharan Africa
STS	Socio-Technical Systems Theory
TPB	Theory of Planned Behavior
UNICEF	United Nations Children Fund
WASH	Water, Sanitation and Hygiene
WASREB	Water Service Regulatory Board
WHO	World Health Organizations
WRA	Water Resources Authority
WRI	World Resources Institute
WUAs	Water Users Associations
WASH	Water Sanitation and Hygiene
WV	World Vision

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CHAPTER ONE
INTRODUCTION

1.1 Chapter Introduction

This chapter provides the background to the problem of community-managed water supply access, both locally and globally, which forms the development issue at stake in the current study. Additionally, the chapter contains the historic development of community-managed water services laws and policies, as well as management and sustainability issues, and the growth of CWMS systems in Nakuru County. Against this backdrop of sustainability issues, the research assessed the household and governance factors associated with sustained access to CMWS services. Other parts of this chapter include the rationale of the study, the scope, limitations, and the assumptions guiding the research design and interpretation of findings.

1.2 Background to the Study

Lack of access to safe and reliable water remains one of the most urgent development challenges affecting approximately 2.1 billion people globally (WHO & UNICEF, 2025). This is in spite of efforts to achieve Sustainable Development Goal 6, which aims to ensure availability and sustainable management of water and sanitation for all. Low- and middle-income countries (LMICs) bear the disproportionate burden of people who lack access to improved water sources and the health burden associated with consumption of unsafe water (Deal, 2020; Prüss-Ustün et al., 2019; United Nations, 2015; WHO & UNICEF, 2023). Many governments and development agencies in LMICs lack the financial resources to achieve universal water service coverage, with the majority of their citizens relying on informal service providers (Whittington et al., 2009; World Bank, 2017). For the longest time in the history of water service in Kenya and more specifically in Nakuru County, water provision was the preserve of the centralized models and systems, such as the central government and the municipalities (Mumma, 2007; Ngetich & Onyango, 2018). Omanu & Zumayelleh (2021) observed that community-managed water supply has emerged to fill the gaps left by government service providers. It involves decentralized water supply systems managed by local communities through water user committees, community-managed organizations (CBOs), or cooperatives (Harvey & Reed, 2007; Schouten & Moriaty, 2003; Whaley & Cleaver, 2017). According to Whaley & Cleaver (2017), these systems are critical in bridging water access gaps, particularly in low- and middle-income countries where centralized infrastructure is limited. However, they face multiple financial, operational and governance challenges that threaten their sustainability. The financial challenges stem from inadequate

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revenue collection and low affordability among low-income households. The operational challenges include frequent equipment breakdowns that cause service interruptions and limited maintenance capacity. The governance challenges consist of unaccountability among the management committees, limited water user committee training, and lack of popular participation in decision-making (UNICEF, 2023; WHO, 2019). Studies on the issue indicate that approximately 40% of the rural community-managed water systems in sub-Saharan Africa undergo periodic non-functionality that underscores the severity and persistence of these challenges (Harvey & Reed, 2007). The status of CMWS varies significantly between urban and rural households, reflecting differences in infrastructure, governance, and socio-economic factors. For instance, 90% of the urban population in the SSA lacks access to piped water compared to only 60% of the rural population, who always experience frequent interruptions in the region (WHO & UNICEF, 2021). This decentralized approach plays a particularly vital role in rural areas where centralized systems are economically or geographically unfeasible, while also serving as an essential stopgap in peri-urban and informal settlements, ensuring household engagement in the community-managed water services management (Whaley & Cleaver, 2017; United Nations, 2023; & Ngetich & Onyango, 2018). Oumanu & Zumayahelleh (2021) pointed out that the Kenyan rural populations rely on the protected springs, handpumps, and boreholes that are prone to non-functionality for a few weeks in a year. These differences generate heightened population vulnerability, exposure to waterborne illnesses, and overreliance on unsafe water sources, underscoring the need for policy and alternative interventions that strengthen the reliability, good governance, and sustainability of rural community-managed water supplies.

Globally, an estimated 250 to 300 million households depend on CMWS systems for their primary water supply needs, which serve between 1.15 and 1.35 billion people (World Bank, 2021; World Resources Institute [WRI], 2023). These households are located predominantly in low- and middle-income countries, where infrastructural development often lags behind growing water demands. The World Bank (2021) estimates that 60-80% of rural water supply systems in low- and middle-income countries are managed through community-managed arrangements. This predominance reflects both necessity and policy choice, as extending centralized utility networks to dispersed rural populations often proves cost-prohibitive. Rural CMWS systems typically include a mix of boreholes (40%), hand pumps (30%), protected springs and wells (20%), small-piped schemes (10%), and surface water (45%) (World Bank, 2021). Notably, South Asia and SSA show the highest levels of rural CMWS dependence,

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with 70–80% of rural water points managed by local communities. In contrast, the CMWS are much less in use in urban centers, where piped household utilities and formal water service providers actively dominate the service supply, accounting for over 80% of urban water service access (World Bank, 2021; UN-Habitat, 2020).

The functionality of CMWS varies significantly across regions, with SSA experiencing particularly low performance. Global monitoring data indicates that only 28% of rural households in S the region had access to safely managed water services in 2022 (JMP 2023). This was despite the fact that community organizations were responsible for managing over 70% of rural water points in the region (RWSN 2019). This contrast reveals important insights into the sustainability of CMWS and the level of household agency involved in their governance and use. Low functionality of CMWS between 2010 and 2020 in the region is attributable to a combination of technical, financial, and institutional challenges (Foster et al., 2019; Murray et al. 2023).

Community water committees often operate with minimal training, inadequate access to spare parts, and irregular maintenance schedules for the community-managed hand pumps (Murray et al., 2023). These limitations contribute to frequent system breakdowns and prolonged service interruptions. Furthermore, weak governance structures and a lack of accountability mechanisms within community organizations exacerbate the problem (Machado, Oliveira & Matos, 2022; World Bank, 2021; Waheed, Azhar & Sial, 2023). In many cases, there is little oversight of financial management, leading to poor revenue collection and underfunding of essential operations (WHO & UNICEF, 2023). Moreover, governance issues, such as a lack of training and gender exclusion, affect 70% of the committees, while climate shocks like droughts damage 20% of the systems annually (UNICEF, 2023). In Ghana, 63% of rural water systems are community-managed, serving 10 million people (2 million households) through boreholes and hand pumps (IRC WASH, 2023). However, only 50–60% of these systems remain functional due to financial constraints, as 40% of the served households are unable to pay fees (IRC WASH, 2023). Urban informal settlements in Accra rely on community kiosks for 30% of their water supply, but high costs and contamination reduce their reliability (UN-Habitat, 2023). Hundreds of millions of urban residents rely on CMWS systems (World Bank, 2019; UN-Water, 2022). These systems include standpipes and small-scale vendors (World Resources Institute [WRI], 2023). With an average urban household size of 4, this equates to roughly 37.5 million households (UN-Habitat, 2023). In cities like

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Nairobi, Kenya, and Port-au-Prince, Haiti, up to 60% of informal settlement residents depend on these systems due to the absence of piped connections (UN-Habitat, 2023). For example, in Nairobi's Kibera slum, community-managed water serves 60–70% of households, providing water at a cost 2–3 times higher than utility rates (Water Services Regulatory Board [WASREB], 2023).

In SSA, 80% of slum households lack piped water connections, thus rely on community-managed water systems that frequently fail to meet safety standards (UN-Habitat, 2023). Contamination from fecal sludge in groundwater affects 20–30% of urban community water points globally (UN-Habitat, 2023). The reliance on CMWS in urban areas is highest in this region, where 220 million urban residents (32% of the urban population) lack basic water access, and 60% of informal settlement households depend on community-managed water systems (UN-Habitat, 2023). In Central and Southern Asia, 190 million urban dwellers (18%) rely on CMWS, enhanced by affordability, while East and Southeast Asia and Latin America report 150 million (12%) and 45 million (8%), respectively (UN-Habitat, 2023; WHO/(UNICEF, 2023). Urban CMWS systems face unique challenges, including high operational costs, competition with private vendors, and physical barriers in densely populated settlements. For instance, in Lagos, Nigeria, 40% of peri-urban households rely on community boreholes, but intermittent supply and high maintenance costs reduce their reliability (World Bank, 2023). Additionally, regulatory oversight is often weak, with only 20% of urban community-managed water systems subject to quality monitoring (WRI, 2023).

An estimated 2 million to2.5 million households in Kenya rely on CMWS systems, serving 8 –10 million people (Ministry of Water, Sanitation and Irrigation, 2023; KNBS, 2023). 70–80% of Kenya's rural water points are community-managed, serving 1.8 to 2 million rural households (7 to 8 million people). These systems include boreholes (50%), protected springs/wells (25%), and small piped schemes (15%) (Ministry of Water, Sanitation and Irrigation, 2023). In counties like Kisumu and Siaya, 80% of rural water points are community-operated (KNBS, 2023). In informal settlements, 60% of households rely on community-managed kiosks or vendors, equating to 0.2–0.5 million urban households (1–2 million people). In arid counties like Turkana, 90% of its water points are community-managed, serving 0.3 million people, but 60% are non-functional due to drought and funding shortages (UNICEF, 2023). Governance disputes and lack of technical training exacerbate the issue, with 30% of households relying on unimproved sources during dry seasons (KNBS, 2023). Only 19% of rural households and 39% of urban households have safely managed

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water, with community-managed systems often facing contamination, intermittency, and maintenance issues (WHO/UNICEF, 2023). In Marsabit County, 40% of community boreholes are non-functional. Kwale County achieves 75% functionality due to strong governance, with 90% of its rural water points being community-managed, and serving 0.5 million people (125,000 households) through boreholes and sand dams (KNBS, 2023). Central Kenya reports 65% basic access, with 60% of community-managed water systems being functional (KNBS, 2023). Women-led committees, mobile payment systems (MajiPlus), and private sector partnerships (e.g., Davis & Shirtliff) achieve 75% functionality, compared to the national average of 50% (KNBS, 2023). However, 20% of these systems face water scarcity during droughts, highlighting the need for climate-resilient designs (UNICEF, 2023).

To improve access to safe and affordable water in Nakuru County, community-managed water supply plays a fundamental role, particularly in rural and peri-urban areas such as Njoro and Gilgil sub-Counties, where public utility coverage remains limited. According to the Nakuru County Integrated Development Plan (2023) and WASREB (2023), access to potable water increased from 63% to 66,3%. However, a significant proportion of households in Nakuru still rely on community-managed boreholes, springs, protected wells, piped water schemes, and dams that are operated by community-based organizations (CBO,) water user associations (WUAs) and local committees to meet their domestic and productive water needs (Ministry of water, sanitation and Irrigation, 2023: KNBS,2023). Despite the investment and expansion of these systems, sustained household access remains inconsistent due to frequent breakdowns, unreliable supply, weak governance structures, irregular revenue collection, and inadequate maintenance mechanisms (WAASREB, 2023; UNICEF, 2023). In these rural and peri-urban areas, households continue to face long distances to water points, very high user fees, and poor water quality, especially during the dry season when interruptions are severe (KNBS, 2023; Nakuru County Government, 2023). These challenges have affected not only domestic use but also livelihood activities such as livestock keeping, small-scale irrigation, and household microenterprises that depend on reliable water (Ministry of Water, Sanitation and Irrigation, 2023; FAO, 2022).

Household sustained access to community-managed water services in Nakuru County is influenced by several interrelated household and institutional factors. Household socio-economic status, which includes education level, main source of income, family size, and marital status, determines the household's ability to pay water users' fees, maintain piped

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water connections, and continue relying on piped water services over time. Furthermore, access to water for livelihood activities such as livestock keeping, vegetable watering, and resale of water to neighbors strengthens household dependence on community-managed water services by increasing the economic value attached to reliable water access. In addition, convenience of water services, especially in areas distant from water points and main pipes, water supply availability, and affordability of service charges, affect continued use and dependence on community-managed water systems. Household perceptions of quality, reliability of supply, and responsiveness of service providers also shape users' satisfaction and the long-term sustainability of access. Governance practices such as trust in participatory decision-making, accountability, confidence in water management, and participation of users in management processes influence household willingness to contribute financially and remain connected to the piped water system. Understanding how these variables interact helps explain why some households sustain access while others do not, despite living within the same service areas.

Studies in Nakuru County have demonstrated that weak institutional accountability, low household participation in water governance, poor financial sustainability of water projects, and limited technical capacity among water management committees significantly contribute to system failure and household disconnection from piped water services (Kope & Koehler, 2020; Komu et al., 2018; WASREB, 2023). This makes Nakuru County the most appropriate context for examining how household and governance factors influence the sustained use of community-managed water services and the long-term sustainability of piped water access.

1.3 Statement of the Problem

Despite the widespread adoption of community-managed water supply (CMWS) systems as a strategy to improve access to safe and affordable water in less developed and middle-income countries, their long-term sustainability remains a challenge. Globally, approximately 30-40% of community-managed water systems are non-functional at any given time. Only 30–50% of households depending on these CMWS have access to safely managed water services (WHO, 2019). In rural areas, 60% of community-managed water points experience functionality issues. These issues include systems breakdowns, water quality deterioration, and supply interruptions within five years of installation (WHO, 2019). These challenges reflect systemic issues such as inadequate maintenance, limited financial resources for repairs, weak water quality monitoring, and external pressures like climate variability. In urban informal settlements and peri-urban areas, 40% of community-managed systems fail to

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meet established water quality standards. The main causes are poor maintenance, weak monitoring systems, inadequate revenue collection, and limited technical capacity among community managers (WHO, 2019).

The most pressing challenges facing community-managed water services are financial unsustainability, caused by irregular revenue collection, weak governance characterized by poor decision-making and limited accountability, and water quality failures resulting from inadequate monitoring and contamination risks. These persistent challenges are a result of insufficient understanding of the underlying and community-level factors that influence long-term sustainability and effective service delivery. Although significant investments have been made, in decentralization and rural water governance, many households continue to experience unreliable, unaffordable, and unsafe piped water sources. In Kenya, the livelihoods of hundreds of thousands of rural households have been undermined by the failure of community-managed water services. Although these services are increasingly gaining prominence in Nakuru County, sustained access to affordable and safe water from community-managed water systems remains uneven. This occurs despite decades of investment and decentralization in water governance. Consequently, evidence-based guidance for policy and practice is at times contradictory.

Furthermore, metrics for assessing governance dynamics, such as transparency in decision-making, accountability, and confidence in the water committee, have remained inadequate. Thereby limiting comparability of results across regions (Hope & Koelbl, 2020; Komu et al., 2018). Scholars report conflicting findings regarding whether the households' SES, reliability, or affordability is the greatest determinant of sustained access to piped water services (Hope, 2015; Kanyoka et al., 2020). Similarly, current research on water service convenience and availability leads to conflicting conclusions. Most scholars associate shorter distances with sustained access, while others observe negligible effects due to quality concerns (Whittington et al., 2019; Wasonga et al., 2014). Existing evidence on the measurement of the quality of water service and livelihood outcomes is mostly qualitative. This reduces understanding of the magnitude and nature of household-level economic gains from participating in a community-managed water system (Adams et al., 2019; Mogaka, 2020). This fragmented empirical evidence base obscures understanding of how household and governance factors shape the sustainability of piped water service delivery from community-managed water supply systems in Nakuru County. Consequently, few studies have quantitatively and qualitatively linked these factors to specific failure modes, such as households' sustained

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access to water services. There is therefore a critical need to generate context-specific and evidence-based insights into how these factors interact to influence sustained access to piped water from community-managed water supply systems in Nakuru County. Addressing these gaps will improve policy formulation, strengthen systems management in Nakuru County, and enhance the sustainability of community-managed water supplies. This study, therefore, aims to fill these gaps by examining how household factors and governance mechanisms drive CMWS sustainability. and by generating actionable insights for policy and practice.

1.4 Research Objectives

1.4.1 General Objective

The purpose of this study was to evaluate **household and governance factors influencing sustained access to piped water service from community-managed supply in Nakuru County, Kenya.**

1.4.2 Specific Objectives

Specific research objectives were:

i) To analyze the influence of household socio-economic factors on sustained access to piped water from community-managed water supply.

ii) To assess the influence of livelihood and use of water on sustained access to piped water from community-managed water supply

iii) To examine the influence of water service convenience on sustained access to piped water from community-managed water supply

iv) To evaluate the influence of quality of water service on sustained access to piped water from community-managed water supply.

v) To assess the moderating effect of local governance practices on the relationship between household and governance factors and sustained access to piped water from community-managed water supply.

1.5 Research Questions

The following were the specific research questions.

i) How do household socio-economic factors influence sustained access to piped water from community-managed water supply?

ii) How does access to water for livelihood influence sustained access to piped water from community-managed water supply?

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iii) How does water services convenience influence sustained access to piped water from a community-managed water supply?

vi) iv) How does quality of water service influence sustained access to piped water from a community-managed water supply?

iv) How does the moderating effect of governance practices influence the relationship between household and governance factors and the sustained access to piped water from community-managed water supply?

1.6 Justification of the Study

This study addresses households' sustained access to piped water supply, a fundamental issue to any country's social and economic development. It directly contributes to the country's progress in achieving a majority of SDGs. Reliable; safe and affordable piped water services at the household level support SDGs 6(on clean water and sanitation) by ensuring that households have continuous access to safely managed piped water therefore reducing reliance on unimproved sources. Further, sustained domestic water access enhances good health and wellbeing (SDG 3) as continued access to clean water reduces chances of water borne diseases, improves hygiene and promotes healthy living styles. Additionally, it contributes to SGD 1(no poverty) through reduction of the financial burden associated with buying water from vendors. It also accords them time for productive economic activities such as small-scale irrigation and livestock keeping, which in turn lead to the achievement of SDG 2 (Zero hunger) through enhanced food security and agricultural based incomes. Over and above that, it reduces the time that women and children use fetching water, therefore supporting SDG5 (on gender equality) as they engage more in education and economic activities.

The reason why this research is critical for Nakuru County is that a large proportion of Nakuru rural and peri-urban population [such as Gilgil, Njoro, Molo, and Subukia] is largely dependent on community-managed water systems for their domestic and productive water use. However, despite heavy investment in rural infrastructure and decentralization of water governance, many households continue to experience unreliable water supply, high user fees, disconnections, long distances to the water points and main pipe, poor water quality, and frequent disconnections from piped water services. These challenges affect household well-being, agricultural productivity, livestock keeping, and small-scale enterprises that depend on reliable water access. Further, household sustained access to piped water services has been limited by weak governance institutions, inadequate maintenance systems, irregular revenue

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collections, and low water users' participation. This makes this study critical because it provides context-specific evidence on the household and governance factors that determine whether community-managed water systems remain functional and whether households sustain long-term access to piped water services in Nakuru County. This study contributes immensely to both immediate and long-term improvements in water management practices in Nakuru County. The study results provide empirical evidence for county governments, water committees, community-based organizations, and water users' associations to improve governance transparency and strengthen accountability systems. This reduces the frequency of system breakdowns, improves household satisfaction, and minimizes disconnects from piped water services. In the long run, the study supports the development of a sustainable policy framework for rural and peri-urban water services delivery by informing County water master plans, strengthening supervision of community-managed schemes, and improving integration between community-managed systems and formal water service providers, and making it safe to access while strengthening resilience against climate variability and future water insecurity in Nakuru County.

The study promotes theoretical knowledge by enriching the understanding of the factors that influence sustained access to piped water from community-managed water services. Through the capability theory, it demonstrates how sustained access to piped water services broadens or limits households' freedoms and wellbeing. It evaluates economic factors and livelihood uses, and how access to water services strengthens food security, productivity, and healthy lives. It also exposes how unreliable water services, weak governance and long distances limit people's functionality. Its results deepen the understanding of capability theory by demonstrating the key role of domestic water service access in permitting or restricting household capabilities in the rural and peri-urban settings.

The study advances infrastructure, system breakdowns, and water quality) and social components (governance, participation, and trust) interact to determine sustainability benefits. It reveals how social weakness through lack of accountability and inadequate revenue collection leads to technical failures. Nevertheless, the study reveals that socially united communities still struggle due to poor system maintenance. By analyzing these associations, the study expands the socio-technical theory to community water management, illustrating that household-sustained piped service access is a shared outcome of both social and technological systems functionality.

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The study employed community-based natural resource management principles, hence providing evidence on how community engagement, local governance, and collective action significantly influence sustainable water service access. It demonstrates how fairness in tariff setting, community engagement, transparency and trust in water committees affect households' willingness to pay and continue using piped community-managed water systems. In the same vein, it highlights the limitations of the theory in terms of socio-economic inequalities. Nonetheless, its insights strengthen the CBNRM theory by explaining the reasons behind the failure and success of some community-managed water systems irrespective of policy environments.

The theory enhances Kenya's policy concerning water service providers. Kenya's 2016 Water Act and the Nakuru County water strategies emphasize affordable, well-governed, and reliable water services. However, empirical gaps on household-level challenges such as unreliability, long distances, and weaknesses in governance affect sustained piped water service access in community-managed schemes. This study's findings provide empirical evidence and input for enhancing county strategies and regulations that support water service providers and inform the operationalization of the CMWS and guide the county's water master plan. Furthermore, it offers evidence on governance practices and quality of service, which will influence policies on cost-recovery strategies, participatory management, accountability, and integration mechanisms of CMWS into county supervisory structure. Moreover, Kenya's commitment to achieving SDGs is supported by offering actionable guidance on reinforcing rural and peri-urban community water service sustained access.

The theory directly contributes to the country's progress in achieving the majority of SDGs. Reliable, safe, and affordable water services at the household level support SDG 6(on clean water and sanitation) by ensuring that households have continuous access to safely managed water, thereby reducing reliance on unimproved sources. Further, sustained domestic water access enhances good health and wellbeing (SDG 3) as continued access to clean water reduces chances of waterborne diseases, improves hygiene, and promotes healthy living styles. Additionally, it contributes to SDG 1(no poverty) through reduction of the financial burden associated with buying water from vendors. It also accords them time for productive economic activities such as small-scale irrigation and livestock keeping, which in turn lead to the achievement of SDG 2 (Zero hunger) through enhanced food security and agricultural-based incomes. Over and above that, it reduces the time that women and children use fetching

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water, therefore supporting SDG5 (on gender equality) as they engage more in education and economic activities.

Identifying the influence of socio-economic factors on the relationship between water service models and households' sustained benefits from water service access may assist policymakers in deciding on the appropriate alternative water service. The study provides evidence-based guidance for stakeholders in the planning, financing, regulating, and operating CMWS, which enables them to enhance the sustainability of piped water service access as well as improve piped water access for peri-urban and rural households in Nakuru. The community water committees and the water users' association benefit from the insights on governance transparency in decision-making as well as building the community trust provided in the study. The Nakuru County Government gains from empirical evidence that guides policy formulation, technical supervision of community water schemes, resource allocation, and maintenance support. The local system operators benefit through a better understanding of the technical and service-quality factors that are fundamental to households. NGOs and other interested development partners gain from the context-specific evidence through which they will develop interventions that address households' needs and livelihood concerns. The study helps redefine and reinforce performance monitoring tools and supports the incorporation of indicators reflecting households' sustainability challenges by regulatory agencies.

1.7 Scope of the Study

The study was conducted in Murindat and Njoro wards in Nakuru County, Kenya. It focused on areas served by the community-managed supply systems. These were households that rely on piped-to-household water services, excluding households that primarily depend on any other alternative water sources. In addition, it specifically examined the socio-economic characteristics, livelihood-related water uses, water service convenience, water service quality, and governance factors shaping households' sustained access to water service.

In this study, socio-economic and government factors were treated as conceptually distinct but interrelated determinants of household sustained access to piped water service. Socio-economic characteristics such as main source of income, education level, household size, marital status, age, and livelihood dependence on water influence household capacity to pay for the services, maintain connections, and sustain long-term use of community-managed water systems. Governance factors and management-related dimensions, such as trust in participatory decision-making, confidence in water governance, accountability, trust in leadership, revenue collection practices, and maintenance arrangements, determine how

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effectively water systems are managed and sustained. Governance factors explain the institutional environment that shapes service reliability and water users' confidence. This distinction was critical to avoid conceptual overlap and ensure a clear analysis of how both dimensions independently and jointly influence sustained access to water services.

Methodologically, this study adopted a mixed-method approach that integrates qualitative and quantitative data collection and analysis. Quantitative data were collected using a structured household-level questionnaire to generate measurable evidence on household characteristics and water service experiences, while qualitative data were obtained through focus group discussions to capture lived experiences, perceptions, and contextual explanations concerning governance practices and sustained access to community-managed water services. Therefore, the use of both methods strengthened triangulation, improved validity, and provided a more comprehensive understanding of the research problem.

1.8 Limitations and Delimitations of the Study

1.8.1 Limitations of the Study

Since the study was cross-sectional, it was unable to capture changes over time. It was not able to capture the possible long-term changes in the sustained access to community-managed water supplies. This limited the causal interpretation of the observed associations.

Some respondents were fully engaged in their livelihood activities, which limited their availability. This was the case because the study targeted rural and peri-urban households who participated in livestock keeping, wage labor, and small micro enterprises, which limited their availability during the data collection hours.

The study experienced time-related non-response bias due to the unavailability of a few households during data collection. Approximately 20% of the respondents required a rescheduled visit, while the unavailable ones experienced different water access constraints. In addition to non-response bias, the study also considered the possibility of selection bias arising from the multistage stratified sampling procedure and the reliance on households available during the data collection period. If a household with different socio-economic and service experiences was systematically underrepresented, particularly those frequently absent due to livelihood activities, selection bias could have occurred.

The study adopted proportional sampling across selected villages and ensured inclusion of households with varied water service experiences, including continuously connected, intermittently connected, and previously disconnected households, to minimize the risk of selection bias. However, potential limitations in generalizing the findings of this study are

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that this study focused on community-managed water services in rural and peri-urban settings. The study also focused on the household and governance factors influencing sustained access to piped water within a local context. Other water access models, such as government–managed schemes, private utility systems, donor-supported projects, or individual household boreholes, may operate under different governance structures and, as a result, factors influencing sustainability in CMWS may not fully apply in such settings. Additionally, socio-economic, cultural, geographical, and institutional differences across regions may limit direct generalization. Variations in income levels, education, water scarcity, climate conditions, population density, and county governance structures can significantly affect the sustainability outcome. Therefore, caution should be exercised when applying the findings beyond the study area, and contextual adaptation is necessary to account for local differences in governance, infrastructure, and policy environments. To mitigate these limitations, the researcher designed a questionnaire that captured a wide range of livelihood indicators. Additionally, the researcher conducted multiple visits outside normal working hours. Moreover, the researcher ensured that the sample size was proportional in its representation of rural and peri-urban households to ensure credibility and balance socio-economic concerns.

The cross-sectional survey design was well-suited to the study objectives because it allowed the simultaneous examination of multiple household and governance factors influencing sustained access to community -managed water services at a single point in time. The design was found appropriate because the study sought to establish associations between socio-economic characteristics, water access for livelihood, experiences with water service convenience, experiences with water service quality, and the moderating effects of governance practices. The design enhanced the efficient measurement of these variables without manipulation of the study environment. The design also enabled comparison of different categories of households based on water service experiences within the selected wards, thereby supporting objective-based analysis of variations in sustained access. Additionally, the mixed-method integration strengthened the design by combining statistical generalization from household surveys with contextual explanations from the focus group discussions, ensuring a comprehensive understanding of both measurable patterns and lived experiences.

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1.8.2 Delimitations of the Study

As regards methodology, the researcher used a cross-sectional survey design to gather data on the association between household and governance influencing factors and sustained access to piped water services from a community-managed water supply in Nakuru County, Kenya, at one point in time from March to June 2024. Data were gathered through household surveys and focus group discussions, excluding key informant interviews. Although key informants could have provided institutional perspectives, the study deliberately relied on users' and household-level experiences.

The study targeted households that relied predominantly on community-managed water supplies for domestic water, which provided piped water services. The study deliberately excluded households getting water from other service models to ensure conceptual clarity and compatibility.

Geographically, the study considered Gilgil and Njoro Sub-counties of Nakuru County. This delimitation enriched the assessment of service access sustainability with selected peri-urban and rural areas where community-managed water services are prevalent.

The target population was delimited using broad operational strata based on water service continuity: households that never experienced water disconnections, households that experienced disconnections and later restored access, and households that never connected back after being disconnected. This categorization focused on service experiences rather than the history of disconnections.

1.9 Research Assumptions

The study assumed that community-managed water supply was the main water service provider in the study sites. This meant that households predominantly relied on these community-managed water supplies for their daily water needs, rather than on alternative sources such as private vendors or public utilities. Given this fundamental role, the performance, service reliability and sustainability of the community water systems directly affect households' access to water.

The study assumed that the community-managed water service providers had achieved significant service coverage since the system's commencement. This assumption implied that the households had enough experience and exposure to the system and would provide meaningful information on the sustainability of water service access. In addition, the assumption suggested that the system had been operating for a long time such that patterns of

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service reliability, governance and maintenance could have emerged. This was fundamental for long-term service access sustainability at the household level.

Additionally, the study assumed that the sampled households were significantly representative of the broader population of households depending on community-managed water services in Njoro and Gilgil sub-counties of Nakuru County. The assumption was based on the use of a multistage stratified sampling procedure and proportional representation of households across different categories of service experiences, including continuously connected households, previously disconnected households, and households with restored connections. The study assumed that the selected participants reflect the diversity of socio-economic conditions, governance experiences, and service access challenges within the study area, thereby allowing the findings to be generalized to similar community-managed water supply contexts in Nakuru County. Furthermore, the study assumed that community-managed water systems had a minimum level of operational reliability, which allowed households to develop sufficient experience in using the services and evaluating their sustainability. Even though service interruptions, breakdowns, and seasonal shortages were acknowledged, it was assumed that the system was functional enough for participants to assess issues such as affordability, water quality, reliability of the supply, and governance effectiveness. Therefore, without this minimum level of services continuity, meaningful analysis of sustained household access to piped water services from a community-managed water services would have been difficult to establish.

The study assumed that community-managed water service providers had significant coverage through individual piped water supply, rather than relying on communal water points. Individual connections were thought to be essential for examining factors such as reliability, affordability, and frequency of disruptions. The assumptions permitted for the household-level service access sustainability without which, sufficient household connections capturing meaningful insights on continued service access would have been difficult.

It was assumed that community-based water service providers involved households in the management of water service delivery. Householders therefore, attended management meetings, contributed monetary and non-monetary services such as labour for maintenance and willingly reported any system breakdowns. By assuming participation, then there was an established connection between community participation and service access sustainability.

The study assumed that water services in the study site were governed and managed by community-drawn leadership and management structure as articulated by WASREB. The

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structure was expected to include accountability mechanism, well-defined leadership roles and water monthly tariff setting procedures. The assumption was critical in linking governance quality to sustained household service access and prolonged system functionality.

1.10 Operational Definition of Key Terms

Improved water source

According to WHO (2023), an improved water source signifies drinking water from constructed supply options to prevent fecal contamination, which is accessible at home and free from chemical contamination. They include a piped household water connection, public standpipe, borehole or tube well, protected dug well, protected spring, rainwater collection and packaged or delivered water.

Unimproved water sources

This refers to water sources that are not adequately protected from external contamination, particularly from human and animal wastes, and therefore may be unsafe for drinking (WHO, 2017). These water sources include unprotected dug wells, unprotected springs, surface water (river, dam, lake, pond, stream, canal and irrigation channels) and vendor-provided water (cart with small tank/drum and tanker truck).

Community-managed water supply

This is a water supply system that is set up for the local community and maintained by the community itself, often through a water committee, water user group, or cooperative where the users contribute fees or labor for upkeep, repairs and management (Muhavende, Dlamini, & Moyo, 2023).

Sustained access to service from a community-managed water supply

This refers to the continued reliable, affordable, and acceptable provision of water to households over time through a water system operated, maintained, and governed by the local community (Lockwood & Smits; Butterworth, 2011).

Household access to water for domestic water use

WHO (2023) defines household access to drinking water as the percentage of the population that reliably obtains at least 20 liters of safe drinking water from improved water sources per householder per day.

Water service coverage

This refers to the percentage of the population with access to improved water services (either within or within reach of a public water point), expressed as a percentage of the population under the utility's relatively modest responsibility (WHO & UNICEF, 2021).

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Piped-to-household water services

This refers to a plumbing system for providing water to a household for domestic purposes from any source, including wells, cisterns, springs, or surface water. This study used the piped-to-household water services to mean the proportion of households that have water piped into their premises (UN-Water, 2021; World Health Organization & UNICEF, 2021).

Conveniences of water services

This refers to distances frequently traveled to obtain water, especially from an improved source of water for domestic needs. According to the WHO, the source should be within 30 minutes round-trip (WHO & UNICEF, 2017).

Household drinking water safety

This refers to the process of ensuring that household water is safe for drinking, food preparation, and personal hygiene to an extent that it does not harm those who use it. To be safe, the water must contain low amounts of harmful contaminants (WHO & UNICEF, 2017).

Safe storage of household drinking water

This is an essential public health strategy done to enhance drinking-water quality and reduce waterborne diseases. It is mainly done with water from unimproved sources and, in some cases, unsafe or unreliable piped water supplies. It comprises practices such as preventing contamination of water sources, treating the water to reduce or remove contamination to the extent necessary to meet the water quality targets, and preventing re-contamination during storage, distribution, and handling of the water (Clasen et al., 2008; World Health Organization, 2017).

Quality of drinking water

It refers to households' perceptions and experiences regarding the safety, cleanliness, taste, odor, and appearance of the water accessed through community-managed water supply (Bain et al., 2014).

Defaulting on payment for water service

This refers to failure to pay for supplied water, hence crippling water service to households, which influences users' service value perception. Additionally, it determines their satisfaction level and affects the operational and financial challenges faced by the utility (Olivier et al., 2017).

Disconnection of water service

This refers to either permanent or temporary excavation and removal of any water supply pipes from a householder's property right up to the boundary (the main network), influenced

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by the consumer's inability and unwillingness to pay the monthly water service fee (Kariuki & Schwartz, 2005).

1.11 Chapter Summary

This chapter features the global and regional overview and context of the problem at stake. Consequently, it elucidates community-managed water supply and community-managed water management as crucial systems in bridging water access gaps in low- and middle-income countries. These systems often face governance, socioeconomic, and distance challenges, which threaten their sustainability in rural and peri-urban societies. Additionally, there are gaps in system maintenance, irregular revenue collection, water treatment, and infrastructure repair; therefore, leaving the household behavioral lens out, volunteers with limited training manage them. These challenges necessitated this undertaking on household and governance factors influencing sustained access to services from community-managed water supply. In addition, the chapter elucidates the research problem and provides the guiding questions, significance, scope, and limitations of the study. The study is justified due to limited context-specific studies of the problem, and the attainment of various SDGs and Agenda 2063. The scope is limited to rural and peri-urban communities in Gilgil and Njoro Sub-Counties of Nakuru County, which rely on household-piped water services. Finally, the chapter outlines the operational definitions of the key terms used.

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CHAPTER TWO
LITERATURE REVIEW

2.1 Chapter Introduction

The chapter presents a review of relevant literature on household and governance factors associated with sustained access to piped water from community-managed water supply systems. The structure of this chapter follows a systematic progression from conceptual understanding to theoretical grounding, empirical evidence, and identification of knowledge gaps. The chapter begins with a review of the concept of sustained access to community-managed water supply systems to establish the meaning and dimensions of sustainability within the context of household water service access. This is followed by a theoretical review of theories related to institutional governance, collective action, and household decision-making and capability. The four theories include Capability Theory, Social-Technical System Theory, the Community-Based Natural Resource Management model, and Common Pool Resources Theory, thereby showing their interface with the study and forming relevant insights for understanding household and governance factors associated with sustained access to community-managed water services.

The chapter then reviews literature on the influence of households' socio-economic characteristics, such as income, education, marital status, age, and household size, on sustained access to piped water from a community-managed water supply. The study shows how livelihood outcomes, such as watering animals, selling water during the dry season, and watering vegetables, as well as engaging in other productive activities, influence sustained access. The chapter further examines the effect of water service convenience, particularly distance to the water points, service availability, and cost of supply, on continued use of piped water services. The literature on the impact of water quality, particularly its dependability and cost, is also examined in this chapter. Lastly, an analysis of the relationship between household socio-economic and governance factors and the household's sustained access to piped water services and the moderation effect of governance dimensions such as trust in participatory decision-making and users' confidence in the water governance. Finally, the chapter closes with an explanation of the conceptual framework and the research gaps.

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2.2 Theoretical Review

The study incorporated the assumptions of four theories in its analysis. These were namely, the Capability Theory, Socio-Technical System Theory, Community-Based Natural Resource Management Theory, and Common Pool Resource(CPR) Theory

2.2.1 The Capability Theory

It was developed in the 1980s through the work of Amartya Sen. Martha Nussbaum developed it further. It objected to the narrow welfare economics that described one's well-being solely in terms of income. It proposes that development should be evaluated in terms of human beings' abilities—the real freedoms or range to achieve valued functioning such as being healthy, accessing clean water, or practicing community life (Sen, 1999; Nussbaum, 2011).

The main tenets of CA include its focus on what people are able to do (capabilities), what they actually achieve (functioning), and the freedom to choose between different ways of living. The approach is inherently people-centered and places emphasis on agency, choice and contextual realities. Karimi et al., (2016) pointed out that the theory acknowledges that different individuals may require different resources to achieve similar outcomes, making it particularly useful in evaluating inequality and exclusion. It questions the well-being of people as influenced by access to safely managed water, without which the same capability is not developed. It emphasizes functional capacity (the ability to live a long life, engage in economic activities, and participate in political activities actively). It champions three principles for quality of life, namely, the people's resources in terms of wealth and income, the resource utility in terms of happiness, and the people's ability "can do or be." Without efficient and effective use, the availability of resources does not lead to households becoming wealthier.

A practical example of the capability approach in community-managed water systems can be seen where two households have access to the same piped water services but experience different outcomes due to differences in income, education, and governance participation. Households with a stable source of income can afford monthly charges and maintain their connection to piped water services, while a low-income household may experience frequent disconnections due to the inability to pay. A household with relatively high education may better understand committee decisions, participate actively in governance meetings, and demand accountability, thereby improving sustained access to water services. In Nakuru

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County, households with reliable access to piped water are better able to engage in livestock keeping, kitchen gardening, and small-scale business, which improve food security and household income. The examples demonstrate that sustained access to water is not about physical infrastructure but also the households' behavioral effect on sustained access to water services from a community-managed supply.

Despite its normative appeal, the theory was criticized for its operationalization challenges. Measuring capabilities is complex and often context-dependent, and selecting which capabilities to focus on can be subjective. Instead, capabilities are inferred from the functions and conversion factors (Sen, 2009; Robeyns, 2017). In this study, the theory was operationalized by sustained access to community-managed water services as a fundamental function, and personal (education, main source of income, and socio-economic factors), social (trust and governance participation), as well as environmental (distances, reliability, and quality) factors were treated as conversion factors. The measurable indicators identified in this study reflect the household's underlying capability to achieve valuable water-related results that are consistent with Alkire (2005) and Nussbaum (2011). In the CMWS context, data collection avails lenses for the identification of households experienced constraints such as literacy, income, and agency that influence sustained water service access, although careful transition into measurable indicators to fit the study's quantitative design.

Its theoretical breadth can make empirical application difficult, particularly in quantitative studies (Robeyns, 2017). The fundamental advantage and disadvantage of capability theory are resource constraints. Resource availability or limitations lead to policy implications. For example, nations are unable to address the rural water supply. The resources, though not adequate, are available, but other related expenditures are not possible. This constraint deprives people of their rights (rights of being healthy, being safe) to choose and become (Nassubam, 2011). In addition, the effects of inaccessibility, unreliability, and affordability of clean water services influence people's health, hours spent at school for children, the inability of women to exploit other activities and opportunities, longevity, and security.

However, the capability approach has been limited, especially in rural water supply studies. Measuring capabilities directly is difficult because they are often inferred from observable outcomes, such as health or income, rather than measured independently (Sen, 2009; Robyns, 2017). Rural areas like Nakuru County differ in terms of culture, poverty levels, and non-cash economies, making capability measurement complex and context-specific. Furthermore, the

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theory is broad and may be difficult in quantitative research without clearly defined indicators such as education level, main source of income, water reliability, and livelihood outcomes as physical and practical proxies for household capabilities and sustained access to community-managed water services.

In the context of rural water supply systems, the capability approach has additional limitations because it places a strong emphasis on individual well-being, while sometimes giving less attention to institutional land governance failures that affect service sustainability. In the context of community-managed water systems, households' capacities are shaped by collective factors such as leadership accountability, committee transparency, and infrastructure maintenance, which the theory does not fully explain on its own. The approach assumes that households have some degree of freedom to choose, yet in many rural settings, access is constrained by geographical limitations, weak infrastructure, and limited service alternatives. Therefore, it is impossible to separate personal capability from structural service constraints. Therefore, even if the theory is useful in explaining household-level outcomes, it requires support from governance and institutional theories to fully explain sustained access to piped water from community-managed supply.

In this research, considering the variations on piped water services, poverty levels, non-cash economies, and the availability of strong local institutions, the approach is instrumental in explaining how sustained access to community-managed water supply expands household capabilities, particularly in health, time management, food security, and income generation (Nassubam, 2011). "Capability" means what people are able to do (what can human beings achieve?) and have agency (their freedom to make choices). In the context of this study, households' sustained access to piped water from a community-managed water supply is regarded as a basic capability since it enables the household to achieve fundamental functioning such as health, food security, income generation, time saving, and participation in productive and social activities. In Nakuru County, both the rural and peri-urban settings with reliable access to piped water services are better able to engage in livestock keeping, vegetable irrigation, and other livelihood activities as well as reduce time spent fetching water. Socio-economic factors such as household size, main source of income, and education act as conversion factors that determine whether households can transform water access into improved well-being. The theory, therefore, informs research objective 1 on socio-economic

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factors and objective 2 on livelihood benefits by explaining how household resources and conditions influence sustained access and the benefits derived from CMWS.

2.2.2 Socio-Technical System Theory

The Socio-Technical Systems Theory (STS) originated in the 1950s through the work of Eric Trist and Fred Emery. It emerged in response to observations made during studies in British coal mines, where attempts to modernize operations by introducing new technologies failed due to a disregard for the social systems in place (Trist & Bamforth, 1951). Later contributions, notably by Appelbaum (1997), advanced the theory into broader organizational contexts, emphasizing the need for joint optimization of technical and social components for effective system functioning. Changes in an organization must consider how relationships among systems are affected, as they are interdependent. All organizations hope to remain in existence for as long as they can (Burke, 2017).

The theory presumes a combination of social and technical elements vulnerable to the environment in a work unit. The essential STS hypothesis is that organizations and services operate through the interaction between two subsystems (Appelbaum, (1997). These systems are the technical system, which encompasses tools, techniques, infrastructure, and work processes; and the social system, which includes people, cultural norms, governance structures, and relationships. The theory posits that neither subsystem needs to be optimized separately; rather, both need to be designed and fitted together in order to produce desired results. In social services like water delivery, the theory suggests that effective provision of service is not only dependent on the physical infrastructure but also on the social organization that supports it. However, STS faces criticism because of assuming smooth integration of the technical and social sides. Critics argue that the theory does not say much about how it is applicable, especially in informal or ill-equipped environments. Furthermore, the theory is blamed for idealizing operation and alignment among and between actors, technologies, and institutional conditions, which are really achieved in the reality of community-managed water services (Mumford, 2006). Previous studies, particularly in the SSA, indicate technical improvements frequently fail because the theory assumes that social arrangements, collaboration in predictable maintenance systems, and accountability are always weak or absent. Additionally, the critics argue that the theory tends to underrate the political and economic constraints therefore affecting the service delivery. The majority of the infrastructure in low-income countries relies on donor dependence, and has inadequate

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resources and institutional fragmentation. (Mumford, 20206; Geels, 2004; and Geels, 2005). The theory also ignores the historic, cultural, and livelihood contexts which shape household behavior. In the Kenyan context specifically, it has been argued that livelihoods (livestock keeping and seasonality) influence water use and decision-making more fundamentally than technological aspects (Burr et al., 2018; Thomas et al, 2019). Additionally, its application in rural locales, for example, in community-managed water supplies, can be constrained by weak institutions and inadequate technical expertise.

This theory effectively explains how effective service delivery depends on the joint functioning of both technical systems (such as infrastructure, tools, and processes) and socio-systems (such as people, governance structures, trust, and community participation) in community-managed water supply systems. This means that the sustainability of the piped water services depends not only on physical infrastructure like pipes, pumps, storage tanks, and boreholes but also on how communities organize maintenance, revenue collection, accountability, and participation in decision-making. In Nakuru County, many systems fail not only because of technical breakdowns but also because of weak governance, poor committee management, low trust in water management institutions, and a lack of popular user participation. Ideally, even where the infrastructure exists and is functioning, households may stop using the piped water if they perceive poor accountability, unfair tariffs, or weak responsiveness from the water management committee. Therefore, the theory helps explain how governance practices such as trust in participatory decision-making and confidence in water governance moderate the relationship between household factors and sustained access to piped water. The theory informs objective 3 on the continuity of water services and the moderating objective on governance practices.

Aligning socio-technical systems in community-managed water services remains a major challenge, particularly in the peri-urban and rural areas in Nakuru County. The technical infrastructure, such as boreholes, pumps, pipelines, storage tanks, and meters, requires regular maintenance, timely repairs, and adequate financial resources. Socio-systems, on the other hand, need effective leadership, transparency, revenue collection, accountability, trust, and active household involvement in decision-making. In many cases, technical failures persist not because repair solutions are unavailable, but because governance systems are weak. Users' fees are poorly managed, maintenance funds are insufficient, and community trust in water committees is low. In practice, delayed responsiveness to a broken pump may

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result from poor financial accountability rather than a lack of technical knowledge. Similarly, households fail to pay water tariffs when they perceive corruption, unfair pricing, or exclusion from management decisions. This scenario weakens revenue collection and undermines technical maintenance, creating a cycle of system weakness. Therefore, household-sustained access to water from community-managed systems relies heavily on the successful integration of both social and technical systems rather than infrastructure alone (Cleaver & Whaley, 2018; Komakech, 2020). In Nakuru County, socio-technical factors such as governance trust, accountability, and community participation influence the performance and sustainability of community-managed water supply systems. Strong governance practices, such as regular maintenance planning, fair tariff setting, transparency in the use of collected funds, and inclusive participation, improve household confidence and willingness to continue using piped water services. Community participation strengthens ownership, reduces vandalism, and enhances collective responsibility for protecting shared water infrastructure. However, where governance is weak, committees are poorly managed, financial transparency is lacking, or users are excluded from decision-making, households often lose confidence in the system, reduce financial contributions, and revert to unsafe water sources. This therefore demonstrates that in Nakuru County, sustained water access is not purely a technical issue but a combined outcome of infrastructure performance and effective local governance.

Application of this theory faces limitations. This theory often assumes that social and technical systems can be easily aligned and optimized, yet in reality, it is difficult in community-managed systems where institutions are weak, technical expertise is limited, and financial resources are inadequate. In Nakuru County, most water projects depend on external donors, irregular household contributions, and volunteer-based water committees, making coordination between infrastructure maintenance and governance structures challenging. Social factors such as interference, low literacy, and unequal participation can weaken accountability and delay repairs, while technical failures such as pump breakdowns or pipe leakages increase mistrust and reduce willingness to pay. Furthermore, the theory pays no attention to broader political and economic constraints such as poverty, drought, and livelihood pressures like livestock keeping and seasonal farming, which strongly shape the household framework for understanding that sustained access to piped water is not purely an engineering issue but a combined outcome of infrastructure performance and effective local governance.

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In Nakuru County, socio-technical factors such as governance trust, accountability, and community involvement have significant influence on the performance and sustainability of community-managed water supply systems. The theory acknowledges that technology cannot stand alone and in a vacuum. Performance of systems relies heavily on the sustained interactions between the hardware (pipes, meters and boreholes) and socio-arrangements (trust, accountability and people participation in decision making). The theory appreciates that rural water supply breakdowns are not caused by mechanical fault alone but by misalignment of social processes such as governance, insufficient maintenance, and conflicting users' expectations (Cleaver &Whaley, 2018; Komakech, 2020).

The Socio-Technical theory complements this study by illustrating how community-managed water services sustained access is a socio-technical outcome generated through sociotechnical and technical infrastructure interaction that supports it (Trist & Emery, 1960; Bostrom & Heinen, 1977). Good governance practices such as regular maintenance planning, fair tariff setting, accountability, and the use of collected funds, and inclusive participatory decision-making improve household trust and willingness to continue using and paying for piped water service. Community participation or involvement enhances ownership, reduces vandalism, and strengthens collective responsibility for protecting and sustaining water infrastructure. However, where governance is weak, committees are poorly managed, financial transparency is lacking, or users are excluded from decision-making, households often lose confidence in the system, reduce financial contributions, and revert to alternative unsafe water sources. Socio-interactions are very important in Nakuru County, particularly because many rural and peri-urban populations rely on community-managed water, rather than formal utility providers. Therefore, the alignment between technical infrastructure and social governance structures directly determines household sustained access over time.

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2.2.3 Community-based Natural Resource Management Model

The Community-based Natural Resource Management (CBNRM) model emerged in the late 20th century, largely in response to the failure of top-down conservation and development programs. Influenced by the work of Elinor Ostrom (1990), who demonstrated that communities could sustainably manage common-pool resources under the right conditions, the model has been widely applied in sectors such as wildlife management, forestry, and water governance. CBNRM emphasizes local participation, property rights, institutional development, and the devolution of resource management to the community level (Fabricius et al., 2004).

At its core, the CBNRM model holds that sustainable natural resource management is possible when communities are given the authority, responsibility, and incentives to manage those resources (Ostrom, 1990). It is based on principles of collective action, community ownership, trust, and localized decision-making. These principles are directly relevant to community-managed water systems, which often rely on voluntary cooperation, local committees, and self-regulation mechanisms. According to Musavengane & Leonard (2022), the advantage of the theory is that it contains a variable that characterizes people's engagement in the preservation of their development resources, while the disadvantages are that the approach does not list the conditioning factors that enable communities to carry out resource management successfully.

This theory is essential in poverty alleviation through the creation of local employment opportunities and community investments. Beneficiaries can use their local technologies and knowledge, giving local people power to control their future (Ostrom, 1990). The beneficiaries can develop and establish accountable and transparent organizations/institutions through democratic processes. In the same vein, Nyenje et al. (2021) argue that the community population distribution is well decentralized and their decision-making process regarding resource management is well structured. Furthermore, convenience of water services and size of their groupings promote interpersonal communication and lower the cost of decision-making and resource management (Ostrom, 1990; Agarwal & Gibson, 1999; Pretty, 2003). This effect creates possibilities for sustainable management of local resources.

Despite its successes, CBNRM has also been criticized. It sometimes assumes that communities are homogeneous and united in interest, which is not the case (Kothari, 200). The theory often assumes that communities are homogeneous and share common interests, yet in reality rural and peri-urban communities such as those in Nakuru County experience inequalities in income, poor land ownership, and access to decision-making. While some households dominate water committees, poorer households, women, and peri-urban users are often excluded from participation in decision-making processes. Additionally, the model allows limited attention to external political and financial influences such as donor dependency, county government interference, weak technical capacity, and climate-related water scarcity, all of which affect the sustainability of water systems. In addition, community involvement alone does not guarantee effective management if there is poor accountability, weak leadership, or corruption in revenue collection. In Nakuru, some water projects fail despite community ownership because of mistrust, poor financial management, and

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inadequate technical support for maintenance. Therefore, while CBNRM provides a strong framework for understanding local ownership and participation, it must be complemented by governance analysis that considers power relations, institutional trust, and technical support systems necessary for sustained access to piped water.

The community-based natural resource management (CBNRM) model is particularly relevant to water management in rural and peri-urban areas such as Nakuru County. This is because most community-managed water supply systems depend on local participation, collective responsibility, and decentralized governance structures rather than formal utility providers alone. The majority of the peri-urban and rural settings in Nakuru County depend on community-managed piped water systems where water users' associations and local committees are responsible for tariff collection, maintenance, planning, conflict resolutions, and protection of water infrastructure. The sustainability of these systems relies heavily on how well the community organizes itself, participates in decision-making, and trusts the management structures in place. For example, in systems where households participate in setting water tariffs, monitoring finances, and making maintenance decisions, they are more likely to develop ownership, contribute financially, and continue using the system. Similarly, proximity to water points and the size of user groups influence communication, cooperation, and accountability, making local government more effective. However, among the peri-urban areas where population growth is rapid and social cohesion may be weaker than in rural villages, managing shared water resources becomes more complex. Unequal access, delayed maintenance, illegal connections, and mistrust of committee members often emerge. The CBRNM model helps explain these realities by strengthening local institutions, community participation, and governance practices. Therefore, it is highly applicable to explaining the sustainability of community-managed water services in Nakuru County.

In rural and peri-urban areas such as Nakuru County, the Community-Based Natural Resource Management (CBNRM) model is highly applicable because most community-managed water supply systems depend on local participation, collective responsibility, and decentralized governance rather than formal utility providers alone. Community water projects in areas such as Gilgil and Njoro rely on water user associations, CBOs, and local management committees for tariff collection, operation and maintenance, conflict resolution, and protection of water infrastructure. The sustainability of these systems depends largely on trust, transparency, accountability, and household willingness to participate in governance

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processes. When households are involved in setting tariffs, monitoring finances, and planning maintenance, they are more likely to develop a sense of ownership, contribute financially, and sustain the continued use of piped water services. However, the model has limitations because it often assumes strong social cohesion and equal participation, which may not exist in peri-urban settlements characterized by rapid population growth, poverty, unequal power relations, and weak institutional trust. In Nakuru County, challenges such as elite capture of leadership positions, poor revenue accountability, illegal water connections, and limited technical support often weaken community ownership and reduce system sustainability. Therefore, while CBNRM provides an important framework for explaining household participation and local governance, it requires support from institutional and governance theories to fully explain sustained access to piped water from community-managed water supply systems (Ostrom, 1990; Fabricius et al., 2004; Cleaver & Whaley, 2018).

2.2.4 Common pool resource (CPR) Theory

The common pool theory was advanced by Elinor Ostrom (1990) to unearth how shared resources like water can be sustainably managed by the communities without relying entirely on privatization or central government control. According to the theory, common resources can be effectively governed when users develop clear rules, shared responsibility, monitoring systems, sanctions, and collective decision-making mechanisms. The main tenets of this theory include clearly defined user boundaries, collective-choice arrangements, local participation, monitoring of resource use, graduated sanctions for rule breaks, conflict resolution mechanisms, and recognition of users' rights to organize themselves. The theory further emphasizes that sustainability depends on trust, cooperation, accountability, and strong local institutions as opposed to infrastructure alone. ŧThe CPR theory is very fundamental in the community-managed water supply system because piped systems and other communal water points are often shared resources that require collective management. Rural and peri-urban households in Nakuru County rely solely on water users' associations and community committees to regulate access, collect tariffs, organize maintenance, and prevent misuse of water infrastructure. The theory assists in explaining that sustained access to piped water is not only on the physical availability of water but also on how households cooperate in managing the shared resources; for instance, when users have trust in water management committees, are allowed to participate in tariff decisions, and comply with payment obligations the system is more likely to remain functional and sustainable. This directly links the theory with the dependent variables of the study: sustained access to piped

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water from community-management supply systems because effective collective management influences continued use, affordability, reliability, and long-term service functionality.

This theory has critical limitations in relation to community-managed water systems. The theory often assumes that communities are socially cohesive and capable of collective action, yet in reality many rural and peri-urban households experience inequality, political interference, elite capture, and conflicting interests. Some households in Nakuru County may dominate the committees, while the poorer households, tenants, women, or peri-urban users may have limited influence in decision-making. the theory also pays limited attention to external factors such as donor dependency, weak country government support, climate variability, drought and technical breakdowns, which strongly affect water system sustainability. In addition, the theory focuses on institutional arrangements but underestimates the importance of technical expertise required for maintaining pumps, pipes, and the storage systems. In the peri-urban areas where rapid population growth and informal settlement weaken social cohesion, collective management becomes more difficult than the theory assumes.

Despite the limitations, the CPR theory remains highly applicable to this study because it provides a strong framework for understanding how governed practices, such as moderating objectives such as trust in participatory decision-making and confidence in water governance, influence the relationship between household factors and sustained access to piped water service. Strong governance structures promote transparency, accountability, and collective responsibility, thereby improving the long-term sustainability of community-managed water systems. In the current study, this theory supports examination of how households' socio-economic factors interact with governance structures to influence the long-term use of community-managed water systems in Nakuru County. The theory specifically supports the moderating objective by explaining how governance practices strengthen or weaken the relationship between household characteristics and sustained access. Thereby moving beyond technical explanations of water supply failure to show that sustainability is largely determined by how communities manage shared water resources over time.

2.3 Empirical Review

This section reviews empirical literature on household factors associated with sustained access to community-managed water services.

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2.3.1 Households Sustained Access to Water from Community-Managed Supply

Community-managed urban systems often provide basic or limited services, with only 30–40% meeting safely managed criteria due to challenges in water quality monitoring, intermittent supply, and contamination risks (WRI, 2023). In contrast, the rural community-managed water system performs even poorer, with only 20-30 meeting safely managed standards, particularly due to distance to water points, technical issues, and a lack of sufficient funding structures (WHO & UNICEF, 2021; World Bank, 2021). In Central and Southern Asia, 190 million urban dwellers (18%) rely on CMWS enhanced by affordability, while East and Southeast Asia and Latin America report 150 million (12%) and 45 million (8%), respectively (UN-Habitat, 2023; WHO/(UNICEF, 2023). Urban CMWS systems face unique challenges, including high operational costs, competition with private vendors, and physical barriers in densely populated settlements. In Sub-Saharan Africa, 80% of slum households lack piped water connections, thus rely on community-managed water systems that frequently fail to meet safety standards (UN-Habitat, 2023). Contamination from fecal sludge in groundwater affects 20–30% of urban community water points globally (UN-Habitat, 2023). The reliance on CMWS in urban areas is highest in Sub-Saharan Africa, where 220 million urban residents (32% of the urban population) lack basic water access, and 60% of informal settlement households depend on community-managed water systems (UN-Habitat, 2023). For instance, in Lagos, Nigeria, 40% of peri-urban households rely on community boreholes, but intermittent supply and high maintenance costs reduce their reliability (World Bank, 2023). Additionally, regulatory oversight is often weak, with only 20% of urban community-managed water systems subject to quality monitoring (WRI, 2023).

The African Union's Agenda 2063 of 2013 is a 50-year strategic framework for Africa's socio-economic and demographic transformation, with universal access to safe and affordable drinking water by 2030 as a key goal aligning with SDG 6. In sub-Saharan Africa, community-managed water supplies (CMWS) are central to this vision, where only 29% of the population has safely managed water (WHO/UNICEF, 2023). Specific targets of Agenda 2063 include Increasing the proportion of community-managed water points to 50% of all water systems in SSA by 2030 up from 35% in 2024 (AfDB, 2023); Ensuring 90% functionality of community-managed systems through legal recognition, structured partnerships and clear ownership rights (African Ministers' Council on Water [AMCOW], 2023); and achieving a 4% annual growth rate in water access coverage, compared to the current 1.2%, to meet universal targets (UN Water, 2023). The agenda targets 80% safely

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managed water coverage in rural SSA, where 70–80% of water points are community-managed, addressing the current 28% coverage (WHO/UNICEF, 2023). This includes scaling up boreholes for access expansion, protected springs, and small-piped schemes to serve an additional 400 million people (AfDB, 2023). In the informal settlements, the target is 60% safely managed water coverage, with CMWS filling gaps for 50–100 million urban residents, considering the unstable or transient populations, low household income, governance limitations via political influences, and technical and spatial constraints (UN-Habitat, 2023). This involves expanding community kiosks and standpipes with quality monitoring (AMCOW, 2023). Agenda 2063 promotes three pillars for CMWS: Transforming informal water committees into legally recognized entities with authority to manage resources, creating structured collaborations between communities, governments, and the private sector to enhance technical and financial support, and establishing clear community ownership to foster accountability and sustained access to services (AfDB, 2023). The African Water Vision 2025, adopted by over 30 AU member states, emphasizes decentralized governance, with CMWS as a cornerstone for achieving equitable access (AMCOW, 2023). Senegal's Rural Hydraulic Department targets 90% functionality for community-managed systems by 2030, aligning with Agenda 2063. Currently, 80% of rural systems are community-operated, serving 5 million people, with mobile payment systems and private sector maintenance contracts ensuring sustained access to service (WHO, 2023). This model is a blueprint for SSA's universal coverage goals.

Community-based water management (CBWM) is a vital component of Kenya's water access landscape, particularly in rural areas and urban informal settlements. The 2010 Constitution of Kenya includes rights to clean and safe water for every citizen (Republic of Kenya, 2010), while the Water Act (2016) advocates accountable, decentralized, and sustainable water services delivery, specifically through community-managed systems in both rural and peri-urban communities. Most recently, the WASREB Strategic Plan (2023–2027) and the WASREB Impact Reports (2022–2023) have emphasized extending regulatory oversight, improving governance and ensuring reliable access to water services in underserved areas (WASREB, 2023a, 2023b). These policy directions align with the current study's focus on household and governance-level determinants of sustained access to service from CMWS in Nakuru County.

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2.3.2 Influence of Household Socio-Economic Factors on Sustained Access to Piped Water from Community-Managed Water Supply

Households' socio-economic factors, such as status and education, main source of income, marital status, as well as family size and age, are critical predictors of household sustained access to service from community-managed water supply. These characteristics fundamentally influence households' capacity to contribute to community water system maintenance, including how they participate in governance structures and adapt to water-saving technologies. Household income and livelihood, for instance, affect affordability and desire to pay for services, while education influences understanding of hygiene and the need to use safe water (Arias-Granados et al., 2022). In general, households with high education and steady incomes are better equipped to contribute significantly to the sustainability and operation of CMWS initiatives. On the other hand, a lower socioeconomic position could lead to delayed water payments and inadequate decision-making participation, which could lead to system collapse (Burt et al., 2019). Additionally, coping mechanisms and water use during service outages are influenced by family size and age distribution (Burt et al., 2019). The community-based natural resource management (CBNRM) concept, which contends that the capacity and incentives of individual families, as well as institutional design, are crucial for the sustainable use of shared resources, continues to place a strong emphasis on socioeconomic factors. In a similar vein, Amartya Sen's Capability approach emphasizes the significance of creating favorable circumstances that empower households to make decisions that result in sustainable resource usage. How people perceive and experience community-managed water supply can differ by socio-demographic characteristics such as age, family size, wealth, sex and education, marital status, employment, among others. The characteristics are expected to influence the effect of livelihood, technical, water service model type, and governance effects on households' sustained access to water services among the rural households.

Across Peru and Bolivia, Arias-Granados et al. (2022) carried out a survey on determinants of rural water sustainability. They employed household surveys and logistic regression to explore the economic predictors of sustained CMWS usage. Key findings showed that long-term use and financial contributions to water systems were positively correlated with the household head's educational attainment and a variety of income sources. Service interruptions resulted from poorer households' difficulties making monthly payments. While the study effectively isolated the education and income effects, the study did not address

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family size and age, which greatly signify the culture of the people of Kenya, therefore creating a gap for the current study.

In South Asia, studies like that of Burt, Z., Ercumen, A., & Nelson, K. L. (2019) focused on household socio-economic factors and community-level dynamics influencing rural water sustainability. This study used a multilevel logistic regression framework to analyze more than 1,000 rural families in Bangladesh and India. The results showed that higher education levels, smaller household sizes, and dual-income households were associated with greater user fee compliance and better reporting of water faults. The study emphasized how education contributed to stronger community participation. Despite providing regional insight, the study lacked African contextual data and overlooked the role of marital status and household leadership structure. For this reason, the current study sought to integrate these variables in a Kenyan context of Nakuru County.

Studies in East Africa, Kenya, and Uganda, specifically studies like those conducted by Hope, R., Thomson, P., & Foster, T. (2020), have explored rethinking sustainability in rural water systems, particularly the role of socio-economic factors. The study employed longitudinal methods in data collection and analysis using smart meters and household surveys. The findings were that income volatility was a key reason for service breakdowns. Additionally, the study results suggested that households with stable income and fewer dependents were more likely to sustain their use than others. Education levels also played a critical role in the prediction of household water service sustainability, especially when water governance was weak. Though insightful, this study focused more on water quantity and payment consistency, not on the full socio-economic factors. The current study incorporated a broader lens and tested associations more comprehensively in a Kenyan context at a county level.

In Malawi, studies such as those of Coulson et al. (2021) were conducted to unearth the cost of sustainable water supply at a networked kiosk in peri-urban centers. The rationale behind the search was to establish how much it cost the water users associations who operate the public kiosks and the water tariffs enforced on the water users. The author argues that the cost of operating a sustainable public service among the rural communities cannot be solely borne by the water users alone. The study emphasizes the tension between the equitable access of community-managed water services and cost recovery. Conclusively, the sustainability of the water services depends not only on the operational cost but also on the

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household economic capacity and tariff-setting mechanism. However, the study tends to separate the operational cost from affordability and household socio-economic assessment. Therefore, there is limited empirical study combing both the WUA financial sustainability and the household economic capacity, while the study emphasises on the affordability there is however insufficient guidance on how tariffs can be structured to balance cost recovery and equity in in the real setting of community managed water services. There is also limited empirical evidence in rural Kenya settings, specifically in Nakuru. There is very little known about how households adjust consumption behavior, coping strategies, or service choice in response to different tariff regimes. The current study aims to bridge the household socio-economic and sustainability of access to piped water services from a community-managed supply.

Even though there has been a lot of discussion about the cost of sustaining rural water systems benefits to households, very little literature exists on how household income levels associate with household sustained access to service of benefits of water services. Household economic considerations are expected to influence recipients' ability to pay water rates as well as the operations and maintenance for water systems. Carter & Ross (2016) suggest households prefer fetching water at kiosks based on the expected household budget. In Botswana, specifically in the Okavango Delta region, studies like those of Gondo et al., employing purposive research methodology, studied the demographic and socio-economic factors. Factors influencing water governance. A sample size of 455 water users as well 9 key informants were selected as observation units. Via descriptive and qualitative analysis, gender inequalities in water provision were realized. In addition, relatively higher water consumption was seen in small households than in large ones. Income levels among the respondents were identified as a key determinant of sustained access to water services. The results agree with the studies of (2018) from Kenya on the water user fee and household ability. The study demonstrated contradictory results, especially on water consumption. The authors also did not categorically identify the water service model under study. The study then opened an opportunity for a study on household factors associated with sustained access to service of community-managed water service in Nakuru County.

In Kenya studies like those of Ndiritu et al., (2018) echoed on community/agency's ability to contribute to the initial project cost does not associate with the knowledge or the willingness to continue sustaining the water services. The community's willingness to pay, the ability to pay and the quantity demanded for water services through the piped-to-household water

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supply are hypothesized to be associated with the household socioeconomic characteristics. The study applied capital structure and sustained access to service models, engaging beneficiaries and the project chairpersons as well as bank managers. Findings from observations, structured questionnaires, and interviews revealed positive but weak associations between user fees and sustained access to water services. However, the author was not categorical on the water service model under study, and the context was different from Nakuru since Kieni is considered more semiarid than Nakuru. The methodology employed by the researcher was distinctly quantitative, therefore limiting the expression of people's opinions and perceptions. The limitations therefore leave an opportunity for the current proposed study.

Olela (2018), in his descriptive and policy-oriented study, dictates that any water tariff be considered; sustained access to the services is only achieved when the community's economic status is considered. If households could afford a one-off payment for connectivity, they would pay lower water tariffs than those who benefit from the public water service. The study is largely qualitative and does not apply advanced statistical modeling or test relationships between variables; instead, it draws conclusions from observed patterns and policy interpretation. This gap paves the way for the current study, which employs a more advanced mixed method and theory-driven analytical framework, which includes qualitative analysis (household survey data, composite indices (socio-status, governance performance, and service quality), inferential statistics (logistic regression analysis), and qualitative analysis (household perceptions of governance and service reliability) and theoretical grounding (capability, socio-technical, and community-based natural resource management).

In Nakuru County, Kenya, studies like those of Joah (2015) note that though overpricing of water services affects the household budget, users' unwillingness to pay, and under-pricing favor the household expenditure on water, leading to the users' unwillingness to pay. Public water services are expected to enhance affordable and accessible water services to those who lack domestic or yard taps. although the author highlights critical insights on tension of water governance as well as balancing the cost for domestic users requirement for the service providers to sustain the services. The study overlooks the community- managed water supply structure as well as not examining differences in income, Education, vulnerability, and household size. Also, the study focuses on the willingness to pay and is therefore limited in its examination of sustained access. The study does not integrate household socio-economic

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dimensions with governance practices nor give sufficient attention to infrastructure performance and service reliability. Although conducted in Nakuru County, the study is specifically not grounded in Kenyan community-managed rural piped water services. Therefore, the current study is critical because it provides contextual evidence from Kenyan rural piped water services operated through community governance; it also incorporates water service reliability and water governance systems and assesses the sustainability and continuity of piped water services over time.

2.3.3 Influence of Access to Water for Livelihood on Sustained Access to Piped Water from Community-Managed Water Supply

Water scarcity affects not only households' domestic use but also their livelihoods (Jonah, 2015b). However, CMWS have grown beyond the mere provision of domestic water into a small-scale rural economic activity enabler, especially for the rural and peri-urban areas of sub-Saharan Africa. In addition to drinking, cooking, and sanitation, households with access to safe water infrastructure also typically use the resource for income activities like selling water to their neighbours, watering their animals and watering their crops. These end-user activities deliver real economic and nutritional gains and enhance household resilience, food security, and pathways to escape poverty (Hope et al., 2020; Mutono et al., 2023). The identification and analysis of these welfare processes are a critical input.

In Kenya, community-managed water systems have become an important part of rural water supply strategies, especially after the 2010 Constitution introduced devolved governance. The move towards community ownership and management of water points, particularly boreholes, protected springs and gravity-fed piped systems aimed to improve access and encourage community involvement and local economic growth (Ministry of Water & Sanitation, 2018). However, the actual benefits from these services are not well documented and are poorly incorporated into water policy assessments. Water is essential to people's livelihoods. Chambers and Conway (1992) define livelihoods as "people, their abilities, and their means of subsistence, including food, income, and assets. A sustainable livelihood is one that can withstand and recover from stress and shocks while also providing for future generations (Munyao, 2015.). Munyao further posits that the fundamental means and ends of sustainable livelihoods are capability, equity, and sustained access to services. Recent studies highlight the need for detailed information on how households use these water services for productive activities like selling water, watering livestock, and irrigating small vegetable plots (Ngigi et al., 2018; Onyango & Wasonga, 2022). Though water is required for a variety

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of activities essential to people's livelihoods, including both domestic (drinking, washing, cooking, and sanitation) and productive needs (vegetable gardening, livestock, brewing beer, brick making), the output of the livelihoods can be influenced directly or indirectly. For example, the cost of water as an input can raise the operating costs of the livelihood enterprise due to water scarcity (Geere, J.A. et al., 2018). However, what is less well known is the significance of water in people's livelihoods and jobs (Muta'aHellandendu, 2012). Water scarcity or availability influences the choice of livelihoods among rural communities (Jonah, 2015b). Muta'aHellandendu (1857) maintains that water scarcity or availability affects the quantity of production, determines the types of crops grown as well as the farming systems practiced. More so, recent studies have referred to the complex interdependence of water resources and food production as an evolving global food crisis(Hope & Ballon, 2019).

Globally, studies such as those of Pouramin et al. (2020) and the World Health Organization and UNICEF (2015) systematically reviewed water and gender inter-linkages. Though not championed by any theory, the study employed a content database analysis. Its results concluded that women encounter risks in their daily water purveyance. Due to a lack of near-homestead water sources, it is expected that women and girls sustain musculoskeletal trauma. In addition, women and girls are expected to ensure quality water for the household; they end up consuming contaminated water. It is, however, expected that in water-scarce areas, women always depend on others to provide security for them on the way to fetch water and at the water points. Water access inequalities for women and girls translate to health burdens and threatened longevity. Water-gender nexus interests social and protective. The study adopted a global perspective without contextualizing findings within a specific rural water governance system, such as those in Kenya. Therefore, this creates a gap that the current study addresses by integrating households' socio-economic characteristics and governance factors to explain the sustained access to piped water services from community-managed water supply in Kenya using a mixed-method and theory-driven approach. According to (UNESCO, 2019; Gärtner et al., 2021), it is expected that the provision of water near their homesteads has excellent potential to reduce the risks associated with water collection. The study posits a limitation in terms of theory, as it also analyzed the existing research focusing solely on women. These studies did not consider the effects of water resource inconveniences among the populations from the rural areas. Secondly, the studies are not specific to the type of water system (piped water or public water services) on which they were conducted. Therefore, there

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is a need to address this gap by analyzing the household factors associated with sustained access to community-managed water service.

In India, according to Tsedai (2021), the relationship between water and economic gains relatively portrays gender inequalities. It is assumed that ownership of assets, control of resources, employment, wages, access to services, participation in the decision-making process, and exposure to risk and management are among the opportunities women are denied by water inaccessibility. According to the study conducted on econometric regression analysis on who benefits from in-house-piped water services in India. The study used spatiotemporal data to study the impact of piped-to-household water services. Though the study had no theoretical basis, the results showed a significant relationship between women's economic gains and indoor water services. The study by Sedai agrees with Hellum et al. (2015), Meeks (2017), and Tortajada (2003), who argue that time wasted by girls and women negatively affects women's employment, personal health, and children's education in developing economies. It also champions improvements in water sources and water service conveniences to reduce the distance to drinking water points, which increases household productivity. Moreover, the results suggest that a 0.1% increase in indoor water services increased the likelihood of women's employment by 0.33%.In addition, indoor water services increased women's earnings by 9.9%, which was assumed to improve their general health. The study further posited that expanded indoor water services promoted children's access to quality education and health improvement. The study is not theoretically grounded and presents the question of why only women are at play. Contextually, the study was conducted in India, which is a developed country compared to Kenya; therefore, the results may not reflect the situation in Kenya since Nakuru is from a developing country. The lack of qualitative methods calls for the current study, which employs mixed methods for data collection and analysis to examine the piped-model household and the governance factors associated with sustained access to community-managed water services.

The study by Geere, J.A. et al. (2018) examined the relationship between water scarcity, household use, and livelihood outcomes. The study, however, emphasizes how water functions as an input among rural and peri-urban household economies. The study highlights that water is not only a basic human need but also a productive economic resource that influences households' enterprises. Conclusively, the study suggests that when water is scarce or not affordable, households experience increased operational burden, which deters livelihood activities, particularly those dependent on water. Since the study was largely

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conceptual and used a secondary data approach, it does not address governance structures or sustained access to piped-water services. The study also lacks household differentiation as well as lacks integration of socio-economic characteristics and governance factors that influence the sustained access to piped water from a community-managed water supply system in Kenya. The current study addresses this limitation by shifting from a global, conceptual analysis of water as a source of input in livelihood activities to a Kenyan-specific empirical investigation of community-managed water supply. Unlike Geere et al. (2018), whose study relies on secondary data and does not examine household governance heterogeneity or sustained access, the current study addresses this gap by integrating both qualitative and quantitative analyses. The integration helps explain the effects of livelihood water uses and their interaction with household arrangements in shaping sustained access to water service from a community-managed water supply in both the rural and peri-urban settings in Nakuru County, Kenya.

Djordjevic & Dasic (2011), in their research on water storage and reservoirs, provided a general technical analysis of water storage and reservoir systems without specifying a particular country or study location. Though the paper did not identify the methodology and the theory employed in the study, it reported that water storage facilities enhance the creation of optimal water management, protection of water, and improvement of hydrological regimes. conclusively the paper highlights that water storage infrastructure is vital in ensuring maximum and efficient use and management through regulation of supply, water resource protection as well as improving the hydrological regimes. The study suggests that storage not only stabilizes availability but also supports household livelihoods. However, the study is limited since the sample size and target population are not clear, and the context and content pose a research gap. Therefore, the current study delves not only into household consumption but also into water's importance in enhancing livelihood resilience. Furthermore, the study focuses on household engagement in animal watering and vegetable cultivation as well as water resale as a source of revenue. In addition, the study assesses households' sustained access to water services and the perceived value of community-managed water supply in both Murindat and Njoro wards in Nakuru County.

In Nigeria, (2019) conducted a study on the effect of water scarcity on households' livelihoods in the Iwoye-Ketu area of Ogun State, (2019) conducted a study on the effect of water scarcity on households' livelihoods in the Iwoye-Ketu area of Ogun State. The study employed multi-stage random sampling to select the respondents among four villages also

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selected through random sampling. In the 80 households selected data was collected using interview schedules. Though the study did not employ any theory, the data were analyzed using descriptive statistics as well as Pearson product-moment correlation, while presentation was done through tables. Many participants (65%) wholeheartedly agreed that they spend more money to obtain enough water for their livelihood activities, and 43.8% agreed that water scarcity reduces the quantity of products that can be produced per time. Moreover, they agreed that obtaining sufficient water for livelihoods is strenuous and affects performance in their livelihood activities (mean = 4.20), that spending all morning looking for water affects the time they arrive at livelihood centers (mean = 4.08), and that a lack of water for livelihoods can affect profits (mean = 4.46). However, this study did not use an inferential approach to show household factors associated with sustained access to community-managed water service. In addition, the model type in this study (tube wells) differs from that in the current study, which engaged in-house connected (piped) and disconnected models.

In Kenya studies such as those of Ngigi, Mueller, and Briner (2019) quantitatively surveyed household livestock water productivity in semi-arid regions of Kenya. The study found that livestock watering was major contributor to households' investment and maintenance of community-managed water supply. Additionally, the results indicated that productive water uses were always in competition and in conflict with households' domestic needs most especially in cases on limited water infrastructure. Though the study produced fundamental insights regarding the productive role of the community-managed water supply, the study was strictly quantitative and therefore failed to incorporate the household's perceptions, governance perceptions, and community-level institutions' insights. The study did not explore how institutional arrangements and governance mechanisms influence water service supply between the domestic and productive sectors. Through a mixed-method and theory-driven approach, the study presents a significant gap, which the current study addresses by examining how household factors such as socio-economic status, livelihood, water access, water quality, and water service convenience, together with governance factors such as participatory decision-making processes, influence sustained access to piped water from community-managed water supply systems in Kenya.

Studies by Muema Ngigi et al. (2018) in their paper on Water access and livestock productivity in semi-arid Kenya highlight the critical role of water access in supporting rural livelihoods, specifically in the livestock-based production system in the semi-arid areas. According to the study, improved access to water services improves household income,

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reduces time and labor for water collection, and strengthens livelihood resilience. The study further shows that water serves both domestic and productive functions, which, as a result, increases household economic value. This implies that households that rely on water for livelihood are more likely to invest in water infrastructure, therefore suggesting a potential link between livelihood use and the sustainability of water systems. Although the study was significant by focusing on productivity outcomes, it does not examine the reliability or continuity of water supply, specifically in relation to sustained access to piped water from community-managed water supply. The study also shows limited attention to governance dimensions such as trust in participatory decision-making, confidence in water governance, and the accountability of the community-managed water management team. The study's scope is narrow, since it is largely centered on livestock while overlooking other livelihood activities such as watering vegetables and selling water during the dry season. Furthermore, the study was predominantly quantitative and therefore lacks qualitative insight into households' experiences; as a result, it fails to explain how livelihood benefits interact with household socio-economic characteristics and governance factors, and how these interactions influence the long-term use of community-managed water services. This study addresses these gaps by adopting a mixed-method approach to examine how access to water for livelihood, together with household and governance factors, influences sustained access to piped water from a community-managed water supply.

Onyango Wasonga (2022) conducted a study in Kenya focusing on rural households and their improved reliance on water for productive activities such as small-scale farming, income-generating enterprises, and irrigation. According to the study results, water service access significantly enhances households' resilience and food security through diversification of livelihood strategies. The study further notes that growing demand for productive water use places additional pressure on existing community-managed systems, affecting service efficiency and availability. Despite the contribution, the study had limited attention on the institutional governance structure, such as accountability and trust among the management team. Additionally, the study focused more on usage patterns than on sustained access outcomes. The study also provides a weak analysis approach on household decision-making behavior, particularly how households allocate and prioritize water scarcity. Consequently, the study did not differentiate the types of water systems, such as community-managed systems versus non-piped or informal water sources. The current study addresses these gaps by focusing specifically on community-managed piped water supply systems in Kenya.

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Furthermore, the current study covers how governance factors and household socio-economic characteristics influence sustained access to water service. The study further incorporates households' behavior and experiences using a mixed-method approach, providing a comprehensive understanding of how livelihood water use interacts with governance systems to shape sustained access to water services from community-managed water supply systems.

2.3.4 Influence of Water Service Convenience on Sustained Access to Piped Water from Community-Managed Water Supply

Globally, the World Bank Group (2017) demands that policymakers must understand household distance to water sources and the presence of water sources and consumption in order to expand and sustain water infrastructure in rural areas of developing countries. Ndiritu et al. (2018) further observe that policymakers take note of the convenience of water services to the water source and water quality at home. There is a need to know the effect of home distance from water sources on the fairness and sustainability of CMWS. Conveniences of water services significantly influence the use and sustainability of CMWS. Homes far from water sources may have several negative effects on the sustainability of the water system in the long term and the health of each household. Moreover, homes within 500 meters of a water source tend to use more water and have greater levels of health and hygiene than homes farther away (Garn et al., 2013). Increased distance to water sources correlates with reduced water consumption, extended collection times, and increased physical strain, disproportionately affecting vulnerable household members, especially women and girls. In many rural communities, women and children are typically in charge of obtaining water; therefore, they are disproportionately affected (Gleick& Iceland, 2018). Petersen-Perlman et al., (2017) observed that long distances make water collection less frequent, which can lead to a shortage of water for basic household and hygiene requirements, endangering sanitation and health. Additionally, if the communal water point is too far or too expensive to access routinely, remote households may rely on alternative, possibly unsafe, or unimproved sources, including rivers, ponds, or shallow wells (Bisung & Elliot, 2018; Graham et al., 2016). In general, households nearer to water points have better access, use more water, have fewer time constraints, and are more satisfied with the services they receive.

It is essential to comprehend how the home conveniences of water services to water sources affect the sustainability and equity of CMWS. Their sustainability and use are significantly influenced by how close houses are to water sources. Problems with water quality, a rise in waterborne illnesses, and an overall deterioration in public health outcomes are the result of

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relying on unsafe and unimproved water sources. Households located far from water stations are less likely to make monetary or social contributions to the upkeep and operation of the CMWS, according to the theory of system sustainability (Geere et al., 2018). Two indispensable components of the community-managed management model-a sense of belonging and community involvement—are undermined by this spatial exclusion.

As (2018) put it, collection of revenue may drop below sustainability levels when remote consumers choose not to take advantage of the service, threatening long-term system functionality and maintenance activities. Remote distances can lower utilization levels, which impact water supply economies of scale. Excessive use of infrastructure intended to cater for a scattered population is common in rural regions, which does not make sense to invest in the repair or improvement of the infrastructure. This aggravates inequality by ensuring that only households closer to the water points enjoy reliable and quality service, while the others remain on the margins (Sorenson et al., 2011; Onyango et al., 2020). Katuva et al. (2016) assert that Kenyan water consumers who live away from water sources are unlikely to pay for services frequently as a result of feelings of unfairness and disregard that lower revenue collection and undermine system maintenance. These factors eventually jeopardize CMWS's viability by reducing household ownership, trust, and engagement. Therefore, the functionality and inclusivity of rural water systems are greatly influenced by the convenience of water services to water sites, which is not only a spatial determinant but also a socioeconomic and governance issue.

Global studies such as those of Garn et al. (2013) delved into unearthing the impact of distance to a water source on water consumption and health outcomes. They conducted a systematic review and meta-analysis of 21 studies across low- and middle-income countries. The study's independent variables were distance between water point and household, while the dependent variables were per-capita water consumption, incidences of diarrhea, as well as the water collection time. They discovered that a greater distance from water sources was consistently associated with higher rates of waterborne illnesses and lower water usage. Particularly, compared to houses farther away, those within a kilometer of a water supply gathered more water and practiced greater hygiene. According to the study, water consumption decreased by 10 liters for every 100 meters of distance. This study provided strong statistical support at the global level; the study ignored the significant impact of institutional and governance issues in mitigating the household distance-to-the-water-point effect. Additionally, its broad conclusions did not adequately account for households' specific

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associations with sustained access to service and community-specific variances, particularly in the rural Kenyan environment where social dynamics and governance forms vary greatly.

Garn J.v. et al, (2013) provide global statistics portraying household access to water services. The study includes distance to water point and convenience of access, as well as the significant effect of water usage patterns and sustainability outcomes. The study results demonstrate that households located near water sources have higher water consumption levels compared to households far from the source. they as well are also said to have better service utilization that contributes to improved water system performance. However, the study focuses mostly on the broad statistical relationship between access and usage without deeply exploring behavioral factors or the role of local government institutions in water service delivery. Furthermore, the study does not sufficiently assess how livelihood activities are affected by water access constraints; additionally, the study does not distinguish between community-managed water supply and the piped water system. The current study, therefore, shifts from a global statistical perspective to a Kenyan-specific empirical investigation focused on Nakuru County. Unlike previous studies that do not consider local institutional dynamics or behavioral responses, the current study focuses on community-managed piped water supply systems while incorporating households' experiences with water convenience, particularly distance to water sources. The study also analyzes two key governance variables (trust in participatory decision-making and confidence in water governance) to explain how institutional arrangements influence water access outcomes. Methodologically, the current study advances the literature by employing a mixed-method approach combined with a composite index that captures multiple dimensions of access, including distance, service availability, and cost of supply, therefore offering a more nuanced and policy-relevant analysis of rural water services sustainability.

In Zimbabwe, Kativhu et al. (2018) examined key factors affecting sustainability in rural Zimbabwe. The study identified conveniences of water services as a significant factor on community-managed water supply access and use. The study, which involved surveys and focus groups at 20 water stations, discovered that families within 200 meters of water sources were more engaged in system maintenance and operational assistance. Sustainability issues resulted from distant households' lower participation and ownership rates. However, the study considered the convenience of water services only as a logistical or physical factor, while overlooking how households' perceptions of service availability, institutional arrangements, and service costs interact with distance to influence long-term use. Furthermore, the study did

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not develop an integrated model capable of predicting sustainability outcomes based on interconnected household factors. These limitations highlight the importance of the current study, which addresses these gaps by applying a logistic regression framework and a composite index to examine the complex relationships between socioeconomic status, governance practices, water service conveniences, and sustained access to piped water.

Still in Zimbabwe, studies such as those of Mushavende, Dlamini, and Moyo (2023) analyzed how multiple uses of water influence the sustainability of communally managed rural water supply systems in Zimbabwe. Using a mixed-methods approach, their study combined household-level interviews in three districts with system performance data. They found that even from more distant homes, water systems serving domestic and productive purposes such as gardening and watering livestock received more consistent use. These multi-purpose systems had relatively shorter out-of-order durations and more frequent financial contributions, which represented an association between perceived value and sustainability. Furthermore, households covered more distance to reach these multi-functional sources, suggesting perceived value and benefits and advantages over distance influenced conveniences of water services.

Although the research provides useful insights into how utility and proximity make the system resilient, several limitations remain. Firstly, the study does not provide disaggregated household-level socioeconomic data. It fails to investigate how variables like asset ownership, household income, or education can potentially moderate or alter the impact of distance on long-term usage. Moreover, it does not cover governance factors such as participation in decision-making processes, transparency in fund use, and trust in water committees. Identifying why some households continue to use water systems over the long run requires understanding institutional parameters. Further, the study is interested in system performance measures at the system level, like downtime and user numbers, but fails to account for household attitudes about the quality of water, reliability, and access equity factors, all of which are also instrumental in deciding on continuous use. Despite providing very fundamental insight, the study had several limitations. The researchers did not use statistical modeling (such as logistic regression) to analyze the association between the convenience of water services and sustainability outcomes, as they treated convenience as a descriptive variable. Disaggregated data such as household income, asset ownership, or education, which moderate the influence of distance on sustainable use, and governance practices factors, including participation, decision-making transparency, and trust in the water

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committee, were not examined. Similarly, while system-level performance indicators were analyzed (downtime, user numbers), household perceptions of water quality, reliability, affordability, and equity were not captured. Furthermore, the study still treated multiuser water systems descriptively without employing statistical modeling to quantify the relationship between the conveniences of water services, livelihood practices, and sustainability outcomes.

To tackle these limitations, the current study in Nakuru County uses an integrated household-based approach. To identify how such variables influence long-term water services access, it accounts for a range of socioeconomic variables, such as asset ownership, household size, education, and main source of income. Institutional trust and governance are conceptualized as moderating variables in this study, specifically reflected in confidence in water governance institutions and trust in participatory decision-making processes. Additionally, the study gathers information on how individuals rate water quality, price, reliability, and responsiveness of customer service, as well as livelihood experiences. The association of convenience, household socio-economic characteristics, water quality, and governance practices in explaining long-term continued use is investigated through a logistic regression model. In conclusion, although Mushavende et al. (2023) offer insightful evidence of the association between conveniences of water services and the sustained access to water services, the study's methodology and scope are limited. The current research fills these gaps by providing a multifaceted, statistically supported, and policy-relevant analysis of the conveniences of water services in connection with the ongoing use of community-managed water supplies.

In rural Uganda, Marks et al. (2020) investigated the relationship between water availability and utilization trends. Using a mixed-methods approach, the study combined structured home surveys and interviews with geospatial mapping to analyse how distance to water sources influence sustained water use behavior. The study found a significant inverse relationship between regular use of better sources and distance to water locations. Families that lived more than 500 meters from a water source were much less likely to continue using the service, frequently turning to risky substitutes when it rained. The study maintains that physical accessibility is a key determinant of water use continuity as well as behavioral choices in rural water systems. Despite the important contribution, the study suffers from various limitations. The study focuses on usage patterns rather than long-term sustained access to water service and does not examine whether water systems remain functional or

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reliable over time. The paper also gives limited attention to governance structures such as community-management arrangements, accountability mechanisms, and trust in decision-making processes. Additionally, the study does not examine the socio-economic and livelihood characteristics. While the study employed a mixed-method approach, the integration of quantitative and qualitative findings is not closely linked to instructional or socioeconomic variables affecting the sustainability of water service access. The current study, therefore, addresses these gaps by examining water service convenience within community-managed water supply systems in Nakuru County, Kenya. The study focuses not only on distance but also on the service availability and cost of supply. It further integrates households' socio-economic characteristics and governance factors, including trust in participatory decision-making and confidence in water governance, to explain sustained access to piped water. Using the mixed-method and composite index approach, the study provides a more comprehensive understanding of how water service convenience influences sustained access to piped water from community-managed water services in both rural and peri-urban settings in Kenya.

In Kenya, Onyango et al. (2020) examined community perceptions on the sustainability of rural water supply projects in Kenya. Their study focused on distance, governance, and satisfaction. They used a cross-sectional survey, with a mixed-methods strategy in the counties of Kisumu and Homa Bay. In addition to other factors including user engagement, payment compliance, and faith in water management committees, the study examined the association between residential distance to water points and views of sustainability. Through key informant interviews and household surveys, the study found that households located farther from water sources frequently had lower satisfaction, less reliable service payments, and less participation in governance procedures. Empirical literature shows that even when improved infrastructure is physically accessible, negative aesthetic qualities discourage households from continued dependence. Remarkably, the study also showed that elements like community confidence in water governance systems and decision-making transparency could lessen the detrimental effects of distance on sustainability. This study was geographically restricted to Western Kenya and, although it was context-specific and insightful, failed to capture the wider spectrum of household experiences, particularly in dry or semi-arid locations like Nakuru County. The study is limited in relation to sustained water access and service convenience. First, it's limited to a single study area in Kenya, which restricts the generalizability of its findings across different contexts. Second, the study does

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not examine how water service convenience translates into sustained access to piped water systems over time. Additionally, governance perspectives are not comprehensively addressed. Factors such as trust in participatory decision-making and confidence in the water management team are not considered. The study does not incorporate a multidimensional analysis approach that combines household socio-economic and governance factors. To address these gaps, the current study examines water service convenience in Nakuru County, Kenya, using a broader set of variables such as household distance to water, water service main pipe, service availability, and cost of supply. In addition, it analyzes how water service convenience interacts with households' socio-economic characteristics and governance factors in community-managed water supply systems to influence sustained access to piped water services. By employing a mixed-method research design and composite index analysis, the study provides a comprehensive regional and policy-relevant understanding of how water service conveyance affects sustained access to piped water services from community-managed water supply systems in both rural and peri-urban settings in Nakuru, Kenya.

In the same vein, Bisung et al. (2015) conducted a study in rural Kenya focusing on water quality knowledge and household water practices. According to the study, a considerable portion of families resorted to unimproved water sources like surface water, rainwater runoff, or shallow wells during the rainy season, even though many had access to improved sources like piped water. Conveniences of water services, shorter travel times, and the belief that rainwater is pure and organic were the main factors behind this change. Although the study by Sai and Walters offers strong evidence about the importance of physical distance, it mainly examined usage patterns without evaluating the ways in which governance factors like confidence in local water committees or decision-making affect long-term use. Furthermore, it did not consider how coping strategies or socioeconomic positions moderate the effects of distance. By incorporating socioeconomic diversity and family governance experiences as moderating and explanatory variables, the current study fills this gap and offers more comprehensive insight into sustainability dynamics in community-managed systems. By offering empirical proof that conveniences of water services and seasonality combine to influence household water choices, this study bolsters the current study in Nakuru County that aims to close the gap left by Bisung et al. (2015)'s failure to examine the ways in which institutional trust, governance experiences, and socioeconomic circumstances impact these changes. Moreover, distance implications go beyond domestic consumption. Households located far from the water points incur higher labor costs as well as opportunity

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costs for small-scale irrigation. Households experience reduced reliability in watering livestock during dry spells and have limited capacity to engage in water selling, making distance a limitation on both livelihood resilience and economic opportunity.

In Nakuru, Jonah (2015) examined factors that impact livelihoods among rural households in Elementaita, Nakuru, Kenya. Among the factors identified, water access and sustained access to services were identified as key. The author did not identify the theory that informed his work, but appreciated the challenges experienced by rural households in the efforts to sustain their water points, irrespective of the convenience of water services. Jonah laments that women and school-going children spend most of their lives fetching water by trekking long distances to get water for domestic consumption. Additionally, Jonah posits that the health benefits are skewed towards communities with water pipes and the populations who have sustainable public water services that enhance livelihoods. The study applied a descriptive methodology, thereby employing systematic sampling to get as few as 200 respondents. Avoidance of a qualitative approach limited the study's findings. In addition, the study was not clear on the water service design and system studied. Since the study did not focus on socio-economic factors such as education, main source of income, marital status, and family size; livelihood benefits; water service convenience; and quality of service, neither did the study examine the moderating effect of water governance practices on the relationship between socio-economic factors, livelihood, water service convenience, and quality of water service. These gaps, therefore, encouraged the analysis of household and governance factors associated with households' sustained access to piped water from community-managed water services.

The examined studies recognize that the convenience of water services influences water use, but they frequently treat distance as a stand-alone factor, neglecting the intricate relationship between family characteristics, governance, and water service quality. No study provides an integrated, multifaceted framework to forecast long-term CMWS use at the household level. The current study addresses these gaps by including moderating variables such as trust in participatory decision-making and confidence in institutional arrangements, using a composite index that includes conveniences of water services alongside socio-economic factors, governance practices, experience with water service quality, and livelihood factors. The application of logistic regression modeling was done to test household-level determinants and predict sustained access to service, focusing on a localized context (Nakuru

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County, Kenya) where challenges to conveniences of water services are compounded by rural infrastructure limitations and governance issues. Therefore, this research not only improves but also substantially expands the knowledge by providing a more thorough, statistically supported, and context-sensitive paradigm for comprehending sustained access to service in community-managed water systems.

2.3.5 Influence of Quality of Water Service on Sustained Access to Piped Water from Community-Managed Water Supply

Household access to community-managed services and usage behavior is heavily shaped by the water quality. Technical assessments of portability are always overridden by the odor, tastes, color, and past health outcomes perceptions in the community-managed context. For instance, if the water seems discolored or tastes bad, households may stop using piped water systems that technically do not meet safety criteria (Domenech & Sauri, 2017; Howard et al., 2020). This discrepancy between household views and expert water testing can reduce the use of otherwise effective systems, which could jeopardize both financial sustainability and health. In relation to the pipe infrastructure, reliability of water supply has become an area of concern. In many rural and peri-urban areas, the majority of households face frequent disruptions due to pipe bursts, pump failure, and poor maintenance. Limited technical expertise and resources at the community level frequently exacerbate these problems (Mudege & Zulu, 2011). In response to this unpredictability, households create coping strategies such as storing water, using untreated sources, or depending on suppliers. In addition to lowering client satisfaction, these behaviours raise household vulnerability and health hazards associated with water. Another important factor that determines continued use of CMWS, especially for economically poor households, is affordability. The economic burden can still be substantial even though community-managed schemes frequently have lower water tariffs than utility-managed systems because of erratic supply, unstated costs, and unofficial vendor charges. According to Kariuki and Schwartz (2019), households in Nairobi's informal settlements were paying up to 10% of their income on water, which is significantly more than the UN-Habitat and WHO-recommended affordability threshold. The opportunity costs of obtaining water and the price of purifying water for safety make this problem much more difficult.

The quality of service in terms of responsiveness and customer care is arguably the most understudied component of the household experience. Households in the majority of CMWS settings have little or no official channels to file complaints, get prompt feedback, or hold

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service providers responsible. In addition to discouraging households from continuing to utilize or pay for services, this lack of responsiveness can damage public confidence in water management committees (Lockwood & Smits, 2011; Whaley & Cleaver, 2017). There is a significant difference in service satisfaction because CMWS typically lack institutionalized channels for user input, in contrast to utility systems that frequently have customer service divisions.

Globally, studies such as those of Doria (2020), who undertook research on the factors influencing public perception of the quality of drinking water, found that users' perception in terms of smell, color, and odor strongly determines households' trust and continued use of the piped water, whether it is treated or not. The study highlights that even when water is scientifically treated and safe for drinking, negative perception significantly reduces household trust and willingness to continue using it. The study further demonstrates that perception of water quality is closely linked to behavioral outcomes, which include continued consumption, switching to alternative sources, or avoidance of piped water systems. furthermore, trust in water service providers and previous experiences with water quality also play a major role in shaping use confidence and sustained use of water service. Therefore, the study concludes that water quality perception is as critical and determinant of water consumption behavior and the long-term acceptance of piped water systems even when infrastructure is available. Despite these impactful results, the study, however, has various limitations. Firstly, the study is based on a cross-national context and fails to focus on community-managed water supply systems or rural and peri-urban settings in Kenya. Secondly, the study lacks analysis of socio-economic characteristics and governance structures. Furthermore, the study does not explore the relationship between water quality perception and sustained access to water service. This study, therefore, addresses these gaps by examining how water quality perception influences sustained access to piped water in community-managed water supply in Nakuru County, Kenya, while integrating household socio-economic factors and governance dimensions using a mixed-methods and composite index approach.

In sub-Saharan Africa, studies such as those by Francis et al. (2015) lament that households often revert to unimproved sources when they detect an unpleasant taste or smell in the available water, even if the improved source is technically functioning. examines how the household's perception of water quality influences continued use of improved water sources.

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The study highlights that households are highly sensitive to sensory attributes of water such as taste, smell, and color. The study findings reveal that even when improved water sources are operational and safe, households tend to abandon them and revert to unimproved sources if the water is perceived to have an unpleasant taste or odor. The behavior underscores the critical role of perceived water quality in shaping user trust and sustained utilization of water service. The study therefore demonstrates that technical functionality alone is insufficient to ensure continued use of piped water systems; rather, user satisfaction and perception of quality are equally important determinants of sustained access. However, the study presents several limitations. First, the study highlights primarily user perception and behavioral response without examining the broader institutions and governance structures that influence water service delivery, such as management accountability and participatory decision-making. Secondly, the study does not analyze the long-term sustainability of the water system but concentrates on immediate user reactions to perceived quality. The study lacks household socio-economic differentiation, failing to explore how factors such as income, education level, or household size influence responses to water quality. Additionally, the study did not consider community-managed piped water systems.

The current study addresses these gaps by examining water quality as a multidimensional component of water service delivery within community-managed piped water systems in Nakuru County, Kenya. The study goes beyond perception to analyze how water quality interacts with governance factors such as trust in participatory decision-making and confidence in water governance, as well as household socioeconomic characteristics, to influence sustained access to piped water. Furthermore, the study incorporates additional services quality indicators, including reliability, affordability, and responsiveness of customer service. to provide a more comprehensive assessment of water service quality. Using a mixed-methods approach and a composite index, the study offers a deeper, context-specific understanding of how perceived and actual water quality jointly influence long-term water service sustainability in rural Kenya.

In Ethiopia, Daniel et al. (2020) examined how perceived water quality influences household preferences and continued use of improved water, such as boreholes. The study observed that poor sensory qualities of water were reducing the use of boreholes. According to the study findings, households preferred surface water despite the possible contamination. This behavior shows the critical role of perceived water quality in shaping household decision-making and sustained use of improved water systems. Further, the study highlights that

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technical safety and the availability of water infrastructure alone are insufficient to ensure continued use, as user perception of quality strongly determines trust and acceptance of water service.

The current study addresses this limitation by adopting a more comprehensive and integrated approach. First, the study goes to immediate usage behavior to examine sustained access to piped water over time within community-managed water supplies. Additionally, the study includes governance factors such as trust in participatory decision-making and confidence in water governance to explain how institutional arrangements influence continued use of water services. Finally, the study focuses specifically on piped water systems, providing a more structured and policy-relevant analysis compared to boreholes. Furthermore, the study integrates household socioeconomic characteristics such as income, education, and asset ownership to understand variations in perception and sustained water use. Using a mixed-method design, the study provides a more robust and context-specific understanding of how water service quality influences sustained access to piped water in both the rural and peri-urban settings in Kenya.

In Nigeria, Oluwasanya (2014) noted that negative aesthetic attributes undermine payment compliance, as well as weakening the users' confidence in the community-managed water systems, which affects the long-term utility. The studies demonstrate that poor perceived water quality weakens the users' payment compliance, which in turn affects the financial sustainability and long-term functionality of water supply systems. In agreement with other studies, this study's findings indicated that water quality perception extends beyond health-related concerns; therefore, it becomes a behavioral determinant influencing water system sustainability. The study insinuates that sensory judgment serves as an indicator of acceptability and use reliance, therefore shaping trust in water services, willingness to sustain use, and commitment to invest and pay for the service on time. However, the study doesn't examine comprehensively how the perceptions interact with household socio-economic characteristics or governance factors, nor does it analyze sustained access to piped water within community-managed water systems. The current study used a mixed-method approach to address these gaps. The study integrates water quality perceptions with governance variables such as trust in participatory decision-making, confidence in water governance, and household socioeconomic factors to explain household sustained access to piped water services from community-managed water services in Nakuru County.

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In Ghana, Domenech & Shauri (2019) assessed the need for household taps by the urban poor. The study provides important information on user experience in a peri-urban setting by establishing a strong correlation between perceived service quality, affordability, and institutional trust. There are still gaps, though, as the study only looks at readiness to pay and ignores post-connection experiences and actual pleasure. It does not include behavioral follow-up to determine whether expressed preferences translate into continued use or continued access, nor does it monitor real water reliability (such as the frequency of outages) after connection. Lastly, it only discusses informal peri-urban Ghana and does not apply to rural or community-managed systems, allowing for a more thorough investigation of the ways in which governance structures influence perceptions and adoption in various contexts. The current study addresses these gaps with a comprehensive and context-specific approach to water service quality and sustained access. While the study by Domenech and Shauri focuses on household willingness to pay for improved water services, the current study goes further to examine post-connection experiences. The study delves to unearth the actual household satisfaction with water service in terms of quality, reliability, affordability, and responsiveness. In addition, the current study incorporates the behavioral dimension by analyzing whether household preferences and perceptions translate into continued use and sustained access to piped water over time. Furthermore, the study goes beyond the peri-urban informal setting to focus on the community-managed water supply system in rural Nakuru County, Kenya, enhancing contextual relevance. The study also provides a deeper examination of the influence of governance practices, which include trust in participatory decision-making and confidence in water governance. This builds an understanding of how institutional arrangements shape user perceptions and long-term adoption of water services. Through a mixed-methods approach, the current study offers more robust, multidimensional, and policy-relevant analysis that addresses the methodological and contextual gaps identified in Domenech and Shauri (2019).

In Zimbabwe, Kativhu et al. (2018) used surveys and interviews (n = 301) to investigate probability, reliability, and service affordability in rural Zimbabwe. According to the results, over 67% reported water shortages; 45% rated water quality as poor, citing taste and color. While the low-income respondents reported water services as unaffordable, satisfaction strongly correlated with maintenance frequency and responsiveness of local water committees. As with Domenech & Shauri, the study links user perceptions to governance but lacks a composite index across experience indicators and does not assess longer-term

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livelihood or sustainability outcomes. The above study is limited by several limitations. first, though the study captures individual indicators such as reliability, affordability, and perceived quality, it fails to employ a composite or multidimensional index to systematically analyze the combined effect of these service quality dimensions on sustained access.

Second, the study focuses primarily on user satisfaction at a single point in time but does not assess whether these perceptions lead to sustained access to piped water services. Second, the governance aspect, such as committee responsiveness, is mentioned; however, the study does not explicitly analyze institutional trust, participatory decision-making, or confidence in water management as the moderating factor that influences sustained access. Furthermore, the study does not consider household socio-economic factors such as education, income, and marital status that may shape how water quality perceptions influence usage decisions. Lastly, the study does not consider the livelihood outcomes such as the role of water access in supporting income-generating activities, food security, or household well-being, which are critical for understanding long-term sustainability.

The current study in Nakuru County, Kenya, addresses these gaps through a more comprehensive and integrated analytical framework. It adopts a composite index approach that combines multiple dimensions of water, such as service quality (taste, color, and smell), affordability, reliability, and service responsiveness, to assess their collective influence on households' sustained access to piped water. In addition, the study goes beyond cross-sectional measures to assess continued use behavior as a proxy for sustained access. The study further includes governance factors such as trust in participatory decision-making and confidence in water management institutions as moderating factors that shape household perception and usage patterns. The study further integrates household socio-economic characteristics to capture the heterogeneity in response to service quality. Finally, the study includes livelihood benefits, therefore providing a broader understanding of how perceived water service quality contributes to sustained access to piped water services from a community-managed water supply.

In Tanzania, Masanyiwa et al. (2019), in their study on household perceptions of drinking water safety with a particular focus on treatment practices such as chlorination, discovered that more than 40% Tanzanian water users believed their water was hazardous since it was not chlorinated regularly or at all. These results repeatedly show discrepancies between family safety perceptions and technological provision. While water quality is a common

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concern in the reviewed studies, few link the perceptions with household-level behavioural responses, satisfaction, or sustained service access. The findings demonstrate a disconnect between household-level perceptions of safety and technical provision of water services, therefore suggesting that the availability of improved water infrastructure does not guarantee user confidence or acceptance. The study underscores the importance of perceived water quality. However, in relation to the current research objective, several limitations are very evident. Though the study captures the perceptions, particularly on water safety, the study does not examine how these perceptions influence household behavior responses, such as continued use or abandonment of piped water services.

Secondly, the study does not analyze user satisfaction as an outcome variable, nor does it establish a link between perceived water quality and sustained access to water services over time. The study also does not comprehensively focus on chlorination and safety perception, incorporating other important dimensions of water service quality such as taste, color, smell, affordability, reliability, and service responsiveness, which collectively shape the user experiences. Additionally, the study does not account for governance factors such as trust in participatory decision-making and confidence in water management, and household socio-economic factors, which are critical in shaping confidence in service. Lastly, the study does not consider the livelihood impact outcomes associated with sustained access to water services from a community-managed water supply.

The current study addresses these gaps through a mixed-methods approach. The study further employs a more comprehensive and integrated analytical framework. The study goes beyond perception by explicitly examining how perceived water quality (smell, color, and taste) influences the behavior and sustained access of piped water services. The study incorporates satisfaction and continued access as key outcome variables, thereby linking perception to long-term sustainability. In contrast to the narrow focus on chlorination, the current study presents a broader, multidimensional approach to water service quality, including affordability, reliability, and service provider responsiveness. The study also integrates household socio-economic factors to capture variations in perceptions and behavior across different population groups. The study also introduces governance dimensions such as trust in participatory decision-making and confidence in water management institutions as moderating variables influencing sustained access. Finally, the study also incorporates livelihood-related indicators. The study demonstrates a broader understanding of how water

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services quality contributes not only to usage decisions but also to the overall sustainability of community-managed water supply.

Drought leads to more demand for water services among the households and changes in the perception of the quality of water collected. Persistent drought significantly affects the reliability of quality and water access (Esayas et al., 2018; Howard et al., 2016; Macallister et al., 2020; Taylor et al., 2013). In Ethiopia, Macallister et al. (2020) studied the comparative performance of rural water supplies during the drought. With the realization of the unreliability and poor quality of some water point technologies, such as springs and hand-dug wells, the study endeavored to explore the reliability of the motorized hand pumps and the piped water systems.

The study was not clear about the theory that underpinned it. However, it successfully analyzed the performance of 5000 water points in Ethiopia. Its results were that water quantity demanded correlated positively with the source and the use of the water collected. This means that during the dry season, most households reduced the quantity needed for domestic use. However, households only collected water for drinking and cooking, considered quality from the improved source, while other alternative sources served their other needs not considered very dire. The study showed that households prioritize water quality for essential uses such as drinking and cooking and often rely on improved sources for these purposes, but resort to alternative sources that potentially are unsafe or serve less critical domestic needs. The results demonstrate a pattern of selective water use behavior based on perceived quality and availability. In other words, the more persistent the drought was, the more demand for quality water services increased. These results, however, resonate and merge with a profound body of research-based evidence. The literature demonstrates the importance of diverse water sources in response to variations in rainfall. However, the study is limited in relation to the current study objective. The study does not analyze the key sensory dimensions of water quality, such as taste, color, and smell, which are critical in shaping household satisfaction and trust. In addition, the study lacks a multidimensional framework that integrates water quality with other service delivery aspects such as affordability, reliability, and responsiveness. Furthermore, the study does not explain the role of governance factors, including trust in participatory decision-making and confidence in water management, nor does the study account for household socio-economic differences that may influence water use decisions. Importantly, the study does not link perceived water quality to sustained access, willingness to pay, or livelihood outcomes.

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The current study addresses these gaps by adopting a comprehensive and integrated approach that examines perceived water quality using sensory indicators (taste, color, and smell) and links these to household satisfaction and continued use of piped water service. The study also incorporates a multidimensional service quality framework that includes affordability, reliability, and responsiveness while integrating governance variables such as trust in participatory decision-making and confidence in water governance. In addition, the study accounts for household socioeconomic characteristics and includes livelihood-related indicators, thereby providing a more holistic, context-specific, and policy-relevant understanding of how quality of water service influences sustained access in community-managed water supply systems in Nakuru County, Kenya.

In Kenya, Onjala, Ndiritu, & Stage (2014) examined risk perception, choice of drinking water, and water treatment in Kenyan towns. The study was conducted among 1000 urban and peri-urban centers. It explored how perceived piped water risks influence source switching and treatment behaviours. The study findings indicated that perceptions of unreliable or poor-quality water subjected many households to unsafe water sources. Additionally, socio-economic status (education) strongly and significantly influenced willingness to pay for more reliable or higher-quality options. This study explored perception-behavior links but remained urban-centric, without engaging household-level and governance dynamics or community-based systems common in rural Kenya. While the study provides critical insights into the perception-behavior relationship, it focused only on urban areas and did not engage with household-level governance dynamics or community-based water management supply systems, which characterize rural and peri-urban areas such as those in Nakuru County. Consequently, gaps still exist regarding how risk perception interacts with community-managed water services governance experience, proximity factors, and livelihood benefits in sustaining improved water service use in a community-managed water service model.

In Kenya, (2015) explored the introduction of community water supply in rural areas and its impact on community wellbeing and child health. The study employed the cluster sampling methodology, and the possibility of bias in sample selection was inevitable. Furthermore, the observation units were mothers of children younger than5 years. Thus, the choice could have led to bias, since not every woman was given an equal opportunity to participate in the study. The findings of the study implied that the introduction of the water sources improved and changed the household's water sources. In addition, the median distance to the water source

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was drastically reduced by 40% (500 to 300 meters), as was the median collection time, reduced by 50% (30 to 15 minutes). The average household's water consumption increased by about 20% (from 82.6 to 99.0 L), and the consumption of untreated water fell by about 10%. Therefore, the research conducted employed a stratified simple random sampling method, and as a result, all the women head beneficiaries of the piped water services participated in the study. There exists a contextual and content gap, as the study did not consider household-level sustained access to piped water services or the introduction of the piped water model.

According to Agensi et al. (2019), in Kenya, water storage facilities at the household level are associated with quality service and sustained access to service. Households consider piped services if they have ample storage facilities, while households without enough storage facilities would prefer public water services, which, according to them, need no treatment. Therefore, integrated storage systems should be developed and effectively managed to enhance household access to standard water services (Djordjevic & Dasic, 2011). However, the majority of SSA is without water storage facilities. This means that households without storage facilities probably collect water and store it in open gallons (drums). Households with ample storage facilities have the advantage of harvesting and treating rainwater, which can last them for months. The study by claims that the majority of households store water in open jerricans, while only a handful had large tanks, which enabled them to store volumes of water. Water stored without at least two mg/l of chlorine treatment is no different from other direct consumption (WHO, 2017). (2012) maintains that household efforts to provide safe water have been jeopardized by the mishandling and lack of spacious storage, which contaminates water after collection. The study by Agensi employed no theory, and there exists a contextual gap. The study focuses primarily on water storage, therefore overlooking the perceived water quality dimensions such as taste, color, and smell, which are critical in shaping users' satisfaction and continued use. The study did not assess how storage conditions affect household response behavior, particularly whether poor storage contributes to dissatisfaction and eventual discontinuation of piped water use. The study does not integrate storage with other service delivery factors such as reliability, affordability, and service responsiveness. In addition, the study did not focus on governance and institutional factors such as trust in participatory decision-making and confidence in water management. The study also did not assess the sustained water outcomes, including sustained access, willingness to pay, or livelihood implications of water storage and quality.

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The current study, however, addresses these gaps by adopting a more comprehensive and integrated framework that links water service quality directly to sustained access. The study goes beyond storage practices to examine how perceived water quality (taste, smell, and color) influences households' satisfaction and continued use of the piped water system. The study includes a multidimensional set of variables, such as reliability, affordability, and responsiveness of water services. The study also considers governance factors such as trust and confidence in water management, as well as households' socioeconomic characteristics and livelihood indicators. The current study provides a more holistic and policy-relevant perspective. Using mixed methods, this study enhanced understanding of perceived quality, which is sustained by sustained access to community-managed water supply in Nakuru.

On the account of research on water access, little is known about how quality, cost, customer care, factors and dependability combine to affect households' decisions to keep using community-managed water supply. Most current research presents a fragmented picture of the user experience by focusing on just one or two of these elements. Others focus mostly on systems that are governed by cities or utilities, ignoring the particular dynamics of rural and peri-urban communities. Moreover, many of these studies lack the theoretical frameworks necessary to explain how family experiences interact with socioeconomic status, governance models, and spatial closeness to water stations (Hope et al., 2014; Lockwood & Smits, 2011). In addition to these limitations, the literature's disregard for customer service and responsiveness is a serious weakness. Only a few studies examine the design, effectiveness, or responsiveness of user feedback systems in CMWS, despite the fact that some discuss discontent with service providers. This is a noticeable omission, given that revenue collection, trust building, and the long-term viability of any public service depend on institutional response and customer satisfaction. Furthermore, the local context is still underrepresented in the empirical literature, particularly in places like Nakuru County, Kenya. The majority of national and international studies fall short in capturing the subtleties, coping mechanisms, and community-specific governance mechanisms that affect service sustainability in practice at the home level.

2.3.6 **Moderating Effect of Governance Practices on the Relationship between Household and Governance Factors and Sustained Access to Piped Water from Community-Managed Water Supply**

Community-managed piped-to-households' systems significantly depend on the fabric of maintenance and water network service integrity (Harvey Peter A. & Reed Robert A. 2007;

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World Bank, 2017). Technical aspects of community-managed water systems are redevised into the operational and maintenance phenomena. Operations and maintenance, according to Van Zyl et al. (2014), are believed to be the activities needed to enhance the continuous distribution of water services. Going further, operations are assumed to be the activities that necessitate water service delivery, while maintenance is the activity involved in ensuring appropriate operating conditions, in addition to the technical aspects of water (operation and maintenance) (Ainsworth & Ainsworth, 2004). This perspective is expected to give the system a foundation for being user-friendly and easy to maintain and repair. Water system operation and maintenance is a cost-effective technique to ensure water efficiency, reliability, and safety for both rural and urban households. Inadequate water-using system or equipment maintenance can result in wasteful leaks and losses, as well as early equipment failure (Ainsworth & Ainsworth, 2004). 80% of rural populations in developing countries cite technical factors as reasons for water shortages (Klug et al., 2017). Behnke et al. (2017) study resource mobilization for communiât water services and sustained access to service echoes the management capability to handle repairs and opérations as a solution to sustained access to service. Moreover, Behnke blames management capability to mobilize resources for water services for sustaining access to service. Among the reviewed works, the technical aspect and its implications were not delved into clearly. In addition, the studies incorporated qualitative or quantitative methods, respectively, which implies that none of them could make appropriate generalizations of the results to the entire population without mixed methods. Over and above that, they did not feature public water service operators' experiences, which makes them incomplete. Their contexts and content are also different from those of the current one. This is so because the research unearthed household experiences while using the public water service compared to the use of piped-to household water services in the Nakuru rural and peri-urban areas.

Globally, there is a substantial body of literature that does not examine the governance of water service yet much of it does not adequately address the moderation role of governance practices in shaping sustained access to piped water from a community-managed supply for instance, (Lockwood Harod and smith Stef (2011), world Bank (2017).

In Europe, North America, and parts of the Global South, Studies such as those of Bakker Karen (2018) examine service delivery models and water governance, specifically the shift between public, private, and community-based systems. The study also analyses how

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institutional arrangements, policy frameworks, and service delivery models influence access, efficiency, and equity in water supply systems globally. The key findings emphasize that water services are not merely technical systems but are deeply embedded in political and institutional governance structures. The study further argues that governance arrangements significantly shape service equity, affordability, accountability, and sustainability, with public and community -based systems often facing challenges of weak accountability and institutional fragmentation. however, the study is limited by several gaps. First, the study is largely conceptual and comparative, lacking empirical testing of relationships between variables such as household socio-economic characteristics and governance practices. more so the study does not statistically evaluate the interaction or moderating effects. Second, in this study, governance is treated as a structural system-level factor (e.g., public vs private management) rather than as a dynamic set of practices (trust in participatory decision-making, confidence in water management, and accountability) that influences household-level behavior and sustained access. The study also does not incorporate household socio-economic variables such as income, education, or livelihood activities, which are critical in determining water use behavior and sustained access in community-managed systems. There is also a limited focus on the community-managed water supply systems, specifically, as the analysis is broad and global rather than context-specific. Finally, the study does not integrate governance as a moderating mechanism, meaning it does not explain how governance practices influence the relationship between household factors and service sustainability.

The current study in Nakuru County, Kenya, addresses these gaps by shifting from a global conceptual approach to a context-specific empirical and theory-driven analysis. Unlike Bakker (2018), the current study empirically tests governance practices as moderating variables, specifically trust in participatory decision-making and confidence in water governance institutions, to determine how they influence the relationship between household characteristics and sustained access to water services. Secondly, the study operationalizes governance as a set of measurable behavioral and institutional variables rather than treating it as a structural system classification. Additionally, the study includes household socio-economic factors (income, education, household size, and livelihood activities), enabling a deeper understanding of how household conditions interact with governance systems. Furthermore, the study focuses on community-managed water supply systems, making the findings directly relevant to rural and peri-urban water service delivery in Kenya. Finally, applying a mixed-method and regression-based analytical framework, the study provides a

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more rigorous and interaction-based explanation of how governance shapes sustained access, which is lacking in Bakker (2018).

According to Assunta Di Vaio, Lourdes Trujillo, Gabriella D'Amore, and Rosa Palladino (2020), a global structure review proved a study on water governance models for meeting sustainable development goals, a comprehensive global analysis of water governance frameworks in relation to the achievement of the United Nations Sustainable Development Goals. the study results have it that effective governance mischaracterized through a multi-level coordination, stake holder participation institutional integration and policy coherence. All enhance improved water access efficiency and sustainability.

The study, in addition, emphasizes that governance practices play a critical role e in shaping water management with SDG targets specifically through transparency, accountability, and cross-sector collaboration. However, with regard to the current study objective on the moderating effects of governance practices on the relationship between households and governance factors and sustained access to piped water from community-managed water systems, various gaps in this study are evident. The study adopts a micro-level and conceptual approach, focusing on the institutional policy and framework without incorporating household socio-economic variables or behavioral dynamics. Secondly, the governance practices are conceptualized as structural and system factors rather than as a moderating variable that influences the relationship between households' characteristics and sustained access to piped water services. Furthermore, the study did not empirically test the relationship between variables, as it relies on a literature review methodology, thereby lacking quantitative or mixed methods validation. additionally, the study did not focus on community-managed piped water systems, neither does the study provide an analysis of sustained access outcomes such s continued use and willingness to pay. Critical governance dimensions such as trust in participatory decision-making and confidence in water governance institutions are not operationalized or linked to household behavior.

The current study addresses these gaps by moving beyond conceptual to context-specific, empirical investigation in Nakuru County. The study models governance practices as a moderating variable, including trust in participatory decision-making and confidence in water management, to investigate how access to piped water services works. Unlike the previous study, the current study employed a mixed method. The method integrates both quantitative and qualitative data to capture household characteristics, governance dimensions, and the

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service outcome. Further, the study focuses on community-managed piped water systems, service convenience, quality perceptions, and livelihood factors, thereby providing a holistic and policy-relevant understanding of water service sustainability.

Across various countries in the world, Claudia Pahl-Wostl et all. (2018) conducted a systematic review on water governance. The systematic review synthesized global evidence on water governance across multiple countries and institutional contexts. According to the study results, the governance systems vary significantly depending on institutional, socio-economic, and political contexts and emphasize that effective governance is characterized by coordination across scales, stakeholder participation, accountability, and management. The study further finds that governance agreements strongly influence outcomes such as resource allocation efficiency and equity.

However, in relation to the current study objective (Moderating Effect of Governance Practices on the Relationship between Household and Governance Factors and Sustained Access to Piped Water from Community-Managed Water Supply) several gaps ae evident. First, the study employed a macro-level and comparative approach, focusing on institutional and policy dimensions without incorporating household socio-economic characteristics or behavioral responses. Second, governance is treated as a system-level determinant instead of moderating variables that interact with household factors to influence sustained access. The study also does not empirically assess the relationship between governance and water service outcomes since it relies on a systematic literature review methodology, thereby limiting causal or interaction-based analysis. Furthermore, the study did not focus on community-managed water systems, and nor does it examine sustained access indicators such as sustained access for domestic use or service satisfaction. Finally, the governance dimensions such as trust, participatory decision-making, and confidence in water management are not operationalized to household behavior.

The current research, therefore, addresses these gaps from the global conceptual and cooperative perspective, with a context-specific empirical investigation in Nakuru County. The study models governance practices as moderating variables, particularly trust in participatory decision-making and confidence in water governance. To examine how they influence the relationship between household socio-economic factors and sustained access to piped water. Furthermore, the study employs a mixed-method approach, thereby integrating quantitative and qualitative data with an aim to capture both household behavior and

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institutional dynamics. Additionally, the study focuses on community-managed piped water systems and incorporates household characteristics, service quality perceptions, and livelihood factors, thereby providing a more comprehensive, interaction-based, and policy-relevant understanding of water service sustainability.

Riziki et al., (2019) suggest that, though a majority of the community water projects prefer monetary contribution, the interaction of other factors should not be overlooked or preferred over the different combinations regarding the economic characteristics of the community. The study claims that since NGOs depend on finances from other sources, concerns about other factors influencing public and yard taps remain vital. They purport that resource mobilization management influences community water services accessibility and sustained access to service. They further claim that the committee's quality and capacity in project management and participation determine the length of service supply. However, household water service use and sustained access to service have not featured in their engagement, especially in their mixed models of water service supply.

In relation to the current study objective, the moderating effect of governance practices on the relationship between household and governance factors and sustained access to piped water from a community-managed water system, several gaps are evident. To begin with, the study not only analyzed households' socio-economic factors but also examined how these variables interact with governance practices to shape households' sustained access to piped water from a community-managed water system. Secondly, governance is conceptualized in terms of capacity and participation without being tested as a moderating variable influencing household behavior and sustained use of water services from a CMWS. Additionally, the study did not focus on sustained access outcomes such as long-term usage and livelihood outcomes, particularly with the mixed-method analytical approach. This limited its ability to capture both behavior and institutional dynamics comprehensively. Therefore, the current study addresses these gaps by adopting a mixed-method approach and a theoretically driven framework that integrates household socio-economic characteristics and governance practices. The study models governance variables such as trust in participatory decision-making and confidence in water governance as the moderating variables. The study further delves to unearth the livelihood outcomes within the context of community-managed piped water systems in Nakuru County, Kenya, thereby providing a more comprehensive and interaction-based understanding of water service access sustainability.

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A wide range of government policies and strategies affect rural water supplies, some directly, others indirectly. Many of these have a significant impact on sustained access to water service, intentionally or otherwise. In Uganda, studies such as those by Kelly et al. (2017, p. 4) cite the dynamics through which the community engages the local institutions in resource mobilization for community water support. For example, water committees worked with the community health teams to make and sell bricks. The committee also enlisted schoolteachers to write grant proposals and kept their savings with a local microfinance group to collect interest on loans. The network of community institutions was found to significantly influence resource mobilization for community-managed water systems.

However, the researcher did not identify the resource governance strategies for water points' sustained access to service. Though governance (accountability, transparency) of resources mobilized is assumed to play a vital role in the sustained access to water services, the study did not delve into it. The absence of a theory and methodology employed was found wanting. The area of study and content were also quite different from this study's focus. The study does lack a theoretical foundation, making it difficult to explain the mechanism through which institutional network influence water service sustainability. There is no clear framework linking governance practices to sustained access outcomes. The study also does not examine governance as a moderating variable, particularly how governance practices influence the relationship between household factors such as income and sustained access to water services. Furthermore, the study focuses on resource mobilization activities without linking these to long-term service outcomes, such as continued use, reliability, and system sustainability. Finally, the study context differs from structured community-managed piped water systems, limiting its applicability to the current study setting.

The current study in Nakuru County, Kenya, addresses these gaps through a comprehensive, theory-driven, and methodologically robust approach. The study incorporates governance practices as moderating variables, including trust in participatory decision-making and confidence in water governance. Unlike Kelly et al. (2017), the current study adopts a clear theoretical framework linking household factors, governance, and sustained access outcomes. The study also employs a mixed-method design, combining quantitative and qualitative data to enhance analytical depth and validity. The study also goes beyond resource mobilization to examine governance quality, including transparency, accountability, and responsiveness, and how they affect long-term service sustainability. It directly measures sustained access indicators such as continued use and reliability. In addition, the study integrates household

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socio-economic variables and behavioral response, providing a more holistic understanding of water service dynamics. By focusing specifically on community-managed piped water systems, the study ensures strong contextual relevance and policy applicability.

In Uganda, studies such as those of Daniel Etongo et al. (2018) examined the role of water user committees and capacity development among management committees. Through a mixed-method approach, 642 households across multiple villages were engaged in data collection. The study results show that community water user committees were significantly associated with improved operation and maintenance of water points and that they contribute to sustained access to rural water services. The study further reveals that financial contributions by households are often irregular, and that continued functionality of the water system depends on the effectiveness, skills, and capacity of the water committees. The study concludes that the community-managed water system requires strong institutional capacity and regular training to remain functional and sustainable over time. However, local water committees.

However, with regard to the current study object (the moderating effect of governance practices on the relation between household and governance factors and sustained access to piped water from community-managed systems the study had several critical gaps. First, the study did not examine household socio-economic characteristics such as income, education, or livelihood strategies and therefore does not assess how these factors interact to influence sustained access to piped water services. Second, governance is treated in terms of committee capacity and training. This is not conceptualized as a moderating variable that interacts with household factors to influence sustained access outcomes.In addition, the study focuses on operation and maintenance performance of water points, rather than broader sustained access indicators such as behavioral adaptation and continued access for domestic use. Lastly, the study analysis does not explicitly examine trust, accountability, or participatory decision-making, which are fundamental dimensions in community-managed water services. Additionally, the study is geographically limited to Uganda and does not consider variations in governance dynamics across different contexts, such as Kenya. The current study in Nakuru County, Kenya addresses these gaps by adopting a mixed-methods, theoretically driven approach that integrates household socio-economic factors and governance dynamics within a single analytical framework. Unlike Etongo et al. (2028), the current study explicitly models governance variables such as trust in participatory decision-making and confidence in

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water governance as moderating factors, allowing for the examination of how governance conditions influence the relationship between household characteristics and sustained access to piped water services. Additionally, the study goes beyond operational performance to assess sustained access outcomes, including continued use, service reliability and affordability and livelihood benefits within community-managed piped water systems

In Kenya, studies such as those of (Oyamo, 2018) have established that populations suffer water shortages due to uneven distribution, poor water infrastructure, management, and sustained access to service, and hence their willingness to sustain the services (Oyamo, 2018). In assessing the influence of water supply, Oyamo used descriptive methodology to collect primary and secondary data. The collected data from public water operators and household water consumers led to the conclusion that proper technical operation of public water services significantly influences the reliability, quality, and affordability of water services for poor households.

The study did not use any theory as a foundation. The findings, therefore, raise the question of the role of system management in sustaining access to services and the benefits of water services. The study was limited because the management team was excluded from the sample. More to it, the study was quantitative, therefore limiting the depth of analysis and generalizability, making generalization to a larger population impossible. This weakness calls for a mixed-methods research design in which the type of source, service design, and operation and maintenance are addressed by assessing household factors that sustain the benefits of water services. Additionally, the current study incorporates governance variables as a moderating variable, such as trust in participatory decision-making as well as confidence in water management, in order to examine how these factors influence the relationship between household characteristics and sustained access to piped water. Furthermore, the study goes beyond descriptive analysis by engaging advanced analytical techniques such as logistic regression analysis to test the moderating role of governance factors. By situating the analysis within community-managed water systems in Nakuru County, Kenya, the study therefore yields a context-specific, holistic, and policy-relevant understanding of how governance practices shape sustained access to piped water services from community-managed water supply systems.

Household willingness to continue using either of the water service models is associated with the democratic participation of the service users. Nzengya & Aggarwal (2013) in

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Kisumu studied water accessibility and women's participation along the rural-urban gradient in the Lake Victoria Region, Kenya. Although they studied a rural-to-urban gradient, they did not identify in the journal the theory that informed their study. The study used a face-to-face interview of 307 women in urban (Bondo Township sub-location), peri-urban (Nyawita), and rural (Bar Kowino East, Bar Kowino West, and Ajigo) settings through a stratified means. The findings indicate that peri-urban settlements are not simply an intermediate space between the rural and the urban; rather, these settlements present very different types of challenges than their rural and urban counterparts.

Despite attempts by donor and government agencies to increase women's participation, study findings show that women participate only marginally, with the lowest participation observed among women from peri-urban areas. There exists a contextual gap since their study was conducted in Kisumu while the current one was conducted in Nakuru. The study failed to conceptualize participation as a moderating variable; neither does it test empirically how participation influences the relationship between household factors and sustained access to piped water service. Secondly, the study lacks a theoretical foundation, therefore limiting its ability to explain the mechanism through which governance practices (such as participation) influence behavioral outcomes like continued use of water services. The research focuses primarily on women's participation without integrating broader governance practices such as trust in decision-making, accountability, transparency, and institutional confidence, which are critical in community-managed water systems. Additionally, the study fails to link participation to sustained access, nor does it examine household socio-economic characteristics that may interact with governance practices to influence service sustainability. The study is also largely descriptive, therefore lacking advanced statistical techniques to test integration or moderation effects study focuses on rural-urban gradients in Kisumu; it does not focus specifically on community-managed piped water systems, therefore limiting applicability to structured water service models.

The current study in Nakuru County addresses these gaps by adopting mixed-methods approaches, which combine methodological regression-based modeling, therefore enabling the analysis of interaction effects between governance and household variables. In addition, the current study focuses on community-managed water systems, which ensures relevance to structured rural and peri-urban water services. Furthermore, the study integrates multiple governance dimensions beyond participation, including accountability, responsiveness, and institutional trust and confidence in water management, which builds a more comprehensive

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understanding of governance dynamics. The study also incorporates household socio-economic characteristics and behavioral indicators such as continued use and willingness to pay, which links governance practices directly to sustained access outcomes. Finally, the study adopts a theory-driven and analytically rigorous approach to governance. In the current study, unlike Nzengya and Aggarwal (2013), participation is not treated descriptively; it is operationalized and tested statistically as part of a moderation framework.

In Nyeri, a study by Ndiritu et al. (2018) endeavored to investigate how governance of community-managed water supply is influenced by users' willingness to pay. Based on models of sustained access to service and capital structure theory, 381 respondents were interviewed. Through a descriptive survey design, the study records the establishment of sufficient and affordable service fees, as well as the proper management of returns, as the main issues affecting sustained access to service in community-managed water supply. There exists a research gap since the study was not categorically clear on the models of water systems studied, while the current study investigated the household factors associated with sustained access to service of community-managed water services. The study was conducted in Nyeri, while this study was conducted in Nakuru County, investigating the factors behind why either rural or peri-urban households prefer to sustain community-managed water services. Although the study cites capital structure and sustained access model theories, it lacks an articulated theoretical framework that explains how governance practices interact with household characteristics to influence sustained access. Furthermore, this study does not conceptualize governance practices as moderating variables and does not link institutional factors, such as trust in participatory decision-making, to behavioral outcomes such as willingness to continue using and paying for water services. This creates a need to understand the mechanism through which governance shapes service sustainability, particularly in the community-managed water system context. Moreover, the study does not account for livelihood-related water use, which is increasingly recognized as a key factor behind household engagement in piped water service systems. However, the current study delves into addressing these gaps by first modeling the governance practices as moderating variables, including trust in participatory decision-making and confidence in water management institutions, to assess how they influence the relationship between household factors and sustained access to piped water. The study furthermore adopts a mixed-method design that integrates both qualitative and quantitative data collection, not only statistical relationships but also institutional dynamics and users' experiences.

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The study also incorporates a broader range of governance dimensions, including transparency, accountability, and responsiveness. The study also expands the empirical scope by including household socio-economic characteristics (income, age, education, and household size) and behavioral indicators such as continued use and willingness to sustain the service. Lastly, the study focuses on community-managed water systems, providing more precise and policy-relevant analysis of structured rural and peri-urban water services. It incorporates livelihood-related variables, recognizing the role of water in supporting household economic activities and long-term sustainability. By conducting the research in Nakuru County, which includes both the rural and peri-urban settings, the study enhances contextual diversity and generalizability, therefore offering a more comprehensive understanding of governance and sustained access to water services across different environments.

When stakeholders perceive that their expressed interests and concerns are held accountable for water management decision-making, the probability of sustaining the use of water services from the improved sources is high (Das & Takahashi, 2014; Cleaver &Whaley, 2018). The principle behind rural water service use and sustained access to the service among the rural poor is management. However, this has been through challenges. In Kenya, studies such as of those like Behnke et al., (2017) laments over incapacitated water committees, mismanagement of resources, and insufficient local expertise. the study lacks theoretical foundation therefore limiting its ability to explain the effects of governance variables on the sustained access to piped water services. the study discusses the governance variable s descriptively (e.g. mismanagement, weak committees) but are not operationalized as measurable variables nor are they analyzed as moderation factors influencing the relationship between household characteristics and sustained access.

Concerning resource mobilization, the study identified other options in addition to monetary resource mobilization. The study emphasizes non-monetary resource mobilization (community labor, institutional linkages, local assets), but the study does not examine governance quality, particularly trust, accountability, and transparency in the management of these resources. Through qualitative means, the author expected community and personal assets mobilization, institutional and community mobilization to be alternative means of community-managed water service and sustained access to service. The study does not explore household socio-economic characteristics (income, education, assets) or behavioral responses (continued use, willingness to sustain services), which are critical for

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understanding sustained access. Additionally, the study does not link the governance challenges to measurable outcomes of sustained access, such as reliability, continued use, or service satisfaction. Finally, the study does not analyze the rural and peri-urban areas, yet these contexts significantly influence water service access, governance dynamics, and user behavior.

The issue of trust and accountability in the management of the non-monetary resource did not feature in the study. The methodology applied could have yielded more holistic solutions if the quantitative aspects were also measured. These limitations, especially regarding context and content, therefore call for an assessment of household factors associated with sustained access to community-managed water supply services in Nakuru County, Kenya. The current study addresses these limitations by adopting a theory-driven, mixed-method approach aligned with the research objective. The study first introduces a clear analytical framework in which governance practices are explicitly modeled as moderating variables, which include trust in participatory decision-making and confidence in water governance, thereby moving beyond descriptive governance analyses. Second, governance dimensions such as transparency, accountability, and responsiveness are operationalized and empirically tested, allowing for a deeper understanding of how governance influences sustained access to piped water services from a community-managed water supply.

The study also integrates the results using both qualitative and quantitative methods, enabling the testing of interaction effects between governance practices and household factors using statistical models while also capturing contextual insight from stakeholders. Furthermore, the study incorporates the household socio-economic variables (main source of income, education, household size, and asset ownership) and behavioral indicators (continued use), providing a more holistic explanation of sustained access. Finally, the studies also examine the rural and peri-urban context within Nakuru County, addressing the spatial variation in water service use that was overlooked in Behnke et al. (2017).

2.4 The Summary of Research Gaps

An extensive literature review revealed significant methodological, contextual, theoretical, as well as conceptual gaps. The majority of studies employed only quantitative methods, where data were collected through questionnaires. Therefore, this limited the empirical evidence on how socio-economic factors and governance factors collectively impact sustainable water service access. These studies include Enger et al. (2013); Jonah (2015); Elliott et al., (2017);

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Contzen & Marks, (2018); Ndiritu et al., (2018); and Gärtner et al., (2021). Since this methodology only reports in numerical terms, it is limited since in-depth information, such as the respondents' experiences and opinions, is not included in the results. To address this methodological gap, the researcher adopted the mixed methods, both qualitative and quantitative, in the data collection and analysis. The quantitative information was collected using questionnaires, while the FGD was employed in the gathering of the qualitative data.

A good number of previous studies had no theoretical underpinning, for instance Fonjong & Ngekwi, 2014; Oyamo, 2018; Gondo et al., 2020; and Pouramin et al., 2020. To address the theoretical gap, the capability theory, social-technical system theory, and the community-based natural resource management model informed the current research. The study builds on ideas of the capability theory on the significance of giving people the opportunity to choose, especially in the access and sustained access to the service of community-managed water supply. Additionally, the study adds to Social Technical System Theory by acknowledging that access to sustainable water is both a complex and messy system; moreover, the urge of every organization is to remain viable for as many years as possible. Therefore, social-technical theory enhances both social construct and societal shaping by untangling the complex, interconnected factors of water access and enabling sustained community access to water services. Previous studies reviewed revealed conceptual gaps. Most of them (Enger et al., 2013; Fonjong & Ngekwi, 2014; Jonah, 2015; Oyamo, 2018; Pouramin et al., 2020) examined household water use, sustained access to service, only from gender crises, gender age, water treatment, and the households' livelihood aspects. These studies did not examine the socioeconomic factors, governance and institutional impacts, residential status, water harvesting and storage factors.

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Table 2. 1: The Summary of Research Gaps

Author	Research topic	Key findings	Methodology	Research gaps	Gap current study intends to fill
(Behnke et al., 2017)	Resource mobilization for community-managed rural water systems:	The non-monetary resource mobilization includes mobilization of personal and	**The** paper adopted a qualitative nature, Target population:	Methodological gap: the study was purely qualitative, Population: in three	The study employed mixed methods for data collection and analysis to capture the

	evidence from Ghana, Kenya and Zambia	community assets, institutional and community labour mobilization	18 community-managed water projects. Sample size: 321. Interview guides and focus-group discussions were used to collect the data. Verbatim transcription and thematic analysis were employed	countries;321 respondents were engaged Contextual: Although the study was conducted in Kenya the authors were not clear on the study site(where exactly in Kenya	opinions of the key informants as well as the perceptions of the water users and kiosk operators. The study collected data from a wider sample of approximately 840 water users, project chairpersons, and public water service operators serving water from a project that supplies water through both public water services and pipe-to-household connections. The study was conducted in Nakuru County among both the rural and peri-urban areas.
Elliott et al., (2017)	Multiple household water sources and their use in remote communities with	Most respondents were found to use multiple sources, with differences in source and use.	The paper adopted a cross-sectional methodology. A survey was	Methodology gap. The study only employed the descriptive methodology. Population: the study was conducted only	The study embraced the mixed research methodology as opposed to using either of the 1. The study was

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	evidence from Pacific island countries	There was a difference of source and use affected by wet and dry seasons	conducted among 409 households. Questionnaire was employed in the collection of data Inferential statistics were used to analyze the data	among water users. Contextual: the study was conducted in Pacific Island Countries Conceptual: the study was not specific to the service model under study.	conducted among water users, project chairpersons, and public water service operators. The study was conducted on projects that serve through the public water service and at the same time the pipe-to-household in Nakuru County.
Contzen & Marks, (2018);	Increasing the regular use of safe public water service through collective psychological ownership: A mediation analysis	Participation in kiosk decision-making explained collective psychological ownership of the kiosks.	The study adopted a cross-sectional survey. The study was conducted in one urban and two rural communities The sample included 205 research units. Data were collected using both the structured questionnair	The methodology used was purely quantitative ignoring the aspect of the qualitative which helps delve more on the people's perceptions and opinions Contextual; the study was conducted in Nairobi and Thika. The water source under study was specifically public water services.	The study employed the mixed method to capture the perceptions and opinions of the water users. The study focused on water projects that provide a mixed model water supply (the public water service and pipe-to-households) Nairobi and Thika are from different regions in Kenya; therefore, the results could

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			e and semi-structured interviews Data analysis was through inferential statistics	Data collection was through questionnaires and interviews.	not reflect Nakuru; therefore, the study was conducted in Nakuru. The study employed questionnaires, interview guides and focus group discussions.
Ndiritu et al., (2018)	Pay as You Drink for Sustained access to service of Community Water Projects	There is a significant moderate positive relationship between water user fees and sustained access to services in community water projects.	Inferential statistics were employed in the data analysis. The data were collected among 381 water beneficiaries,2 district officers, and 9 local bank managers through questionnaires, interview guides, and observation schedules.	Methodology gap. The study only employed the quantitative methodology, Contextual gap: the study was conducted in Nyeri County, which experiences different climatic conditions from Nakuru Also, all the water projects were studied without categorizing/specifying on the model Empirical gap: an increase in water users fee led to increase in water project	The study addressed this gap by adopting a mixed method: both qualitative and quantitative data collection and analysis were employed to capture the opinions and perceptions of the key informants. The study was conducted in Nakuru County and on projects that provide services through both the public water service and the piped-to-household.

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				sustained access to service.	
Gärtner et al., (2021)	Keeping water from kiosks clean: strategies for reducing the recontamination during transport and storage in Easter Uganda	The three intervention strategies (chlorination of water, unclean jerricans and cleaned jerricans) significantly reduced E.coli recontamination during transportation and storage over 24 h compared to the control group.	The quasi-experimental research design was employed. The data collected by using the household interviews and structured observations were analyzed using the multivariate regression analysis model. Water samples from public water service were 135 households.	Methodological: The study employed a quasi-experimental method to study the phenomenon. The population used was only 135households, while no information was provided on the total target population. Contextual. The research was carried out in Uganda.	The study applied a mixed-method approach without treatment and control groups. The method encouraged randomization as opposed to the quasi experimentation. The population gap was addressed by engaging 800 respondents sampled from water projects that serve mixed-model water services. The research was carried out in Nakuru, Kenya, as opposed to the one carried out in Uganda.
Jonah (2015)	Water access and sustainable rural livelihoods: A case of	Water availability, affordability, and quality influence the level of household assets	The paper adopted the descriptive survey methodology.	Conceptualization. The paper studied the effect of water to household livelihoods	The current research addressed the gap by engaging the mixed research

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	Elementaita Division in Nakuru County, Kenya	in the community	The data were collected through a questionnaire The researcher also collected data from 195 research units who were identified through a systematic sampling technique. Key informants (water association representative and DO) were also engaged. Inferential statistics was used in the data analysis	Contextual; the study was not categorical o what water projects (model) was studied. Population: the researcher engaged less than 200 research units in a whole division Methodology: the researcher employed purely descriptive research methods.	methodology. It was carried out among households that serve water from water projects that serve through mixed water service models. The sample included the household representative, the water project chairperson, the water project chairpersons, and the public water service operators. The research was categorically on the household factors associated with sustained access to service of community-managed water service in Nakuru county.
Goodall et al. (2016.)	Operational, financial and institutional considerations for	Rural water demand is influenced by rainfall events that shift water use from improved public	The study employed purely qualitative research methodology in the	Methodology. The paper adopted qualitative data collection and analysis	The study used a mixed-methods approach to understand the opinions and perceptions of

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	rural water services: insights from Kyuso, Kenya	water services in the dry season to unimproved sources in the wet season. Water infrastructure development alone doesn't deliver universal water needs	collection and analysis of the findings. The sample included the snowball research technique in the selection of 93 households' representatives and 29 key informants.	techniques. Contextual. The study was conducted in Kitui County. The sample size was only 93 household representatives as well as 29 key informants. Conceptual: the study engaged both the public water services and hand pumps with a piped network.	water users. The targeted population was drawn from projects that serves through both the public water service and the piped-to-households water services The sample included the household heads, the water project chairpersons, and the public water service operators. The study was conducted in selected sub-counties in Nakuru County.
Enger et al. (2013)	Joint effect of efficiency and compliance on household	According to the study, consuming contaminated water even once in a lifetime may undermine the health benefits associated with clean and safe water consumption	In the research design, the paper adopted a quantitative model. The target population was children, though no identification of the size was	Methodology: the research was purely quantitative. The population though a simulation results children the sample size was not clear. Conceptual; the study was on household water treatment	The study delved on implications of water service models to household sustained access to service of benefits of water services. The paper employed mixed methods in data collection and

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			provided. The data were collected and analyzed through inferential techniques.	Contextual; the study was a simulation results from Congo.	analysis. Categorically, the sample was drawn from water service beneficiaries, the water women house head beneficiaries The study was conducted in Nakuru County.
Gondo et al., (2020)	The demographic and socio-economic factors. factors influencing water governance.	Gender inequalities in water purveying were realized as well as relatively higher water consumption in small households than in large ones. Income level among the respondents was identified as key determinant of sustained access to water services	Descriptive and inferential research design was employed to collect and analyze data. A homogeneous purposive sampling technique was used to determine the sample. sample size of 455 water users, as well 9 key informants, were selected as observation units	Contextual; the study was conducted in Botswana. Theoretical. The study was not founded on any theory Empirical; water consumption was found to be relatively higher in small households than in large households.	The study was conducted in Kenya The study was founded on three theories (the capability, the natural resource management and the social-technical system theories) Significance of household socio-demographic characteristics in moderating the household's sustained access to the benefits of water services from the household piped services was delved into.

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(Oyamo , 2018).	In the address of the influence of public water service on water supply.	The collected data among public water service operators and household water consumers led to the conclusion that proper technical operation of public water services significantly influences the reliability, quality, and affordability of water services.	Descriptive methodology to correct both the primary and secondary data. The target population were both the water consumers and the public water service operators The sampling was drawn through a stratified random sampling. Descriptive and inferential statistics was used to analyze and report the data	Contextual; the study was conducted in Mombasa County. Conceptual; the study focused on the public water services only. Theoretical; the study was founded by no theory.	The study was conducted in selected Sub-counties in Nakuru County. The focus was on water services provided to the community through projects that serve both public water services and piped-to-households services. The study was founded on three theories the capability, natural resource management and the socio technical system theory.
Fonjong & Ngekwi, (2014)	challenges of water crises on women activities.	Water quantity and quality are of great concern and affect women's ability to function. The amount of time	The research was descriptive. Employed stratified and simple random sampling	The study did not identify the theory on which it was based. In addition, the study didn't engage any theory. The sample	The study employed mixed research methods. On the theoretical gap, the research engaged 3 theories

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			techniques were employed. The sample size was 167 participants Semi-structured interviews and field observations were used to collect data.	size of 167 respondents was very small compared to the total population, which was more than 50000, raising reliability issues. Methodology: the research was purely qualitative. contextual: the study was conducted in Cameroon, Conceptual; the study focused on the challenges of water crises on women's socio-economic factors. activities.	(capability, Natural resource management, and socio-technical system management theory. Considering the target population, the research units were enough to allow generalization of the results. The study was conducted in Nakuru Count Kenya. On the conceptual gap, the research focused on the implications of water service models to households' sustained access to the benefits of water services.

Source: Author (2020)

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2.5 Conceptual Framework

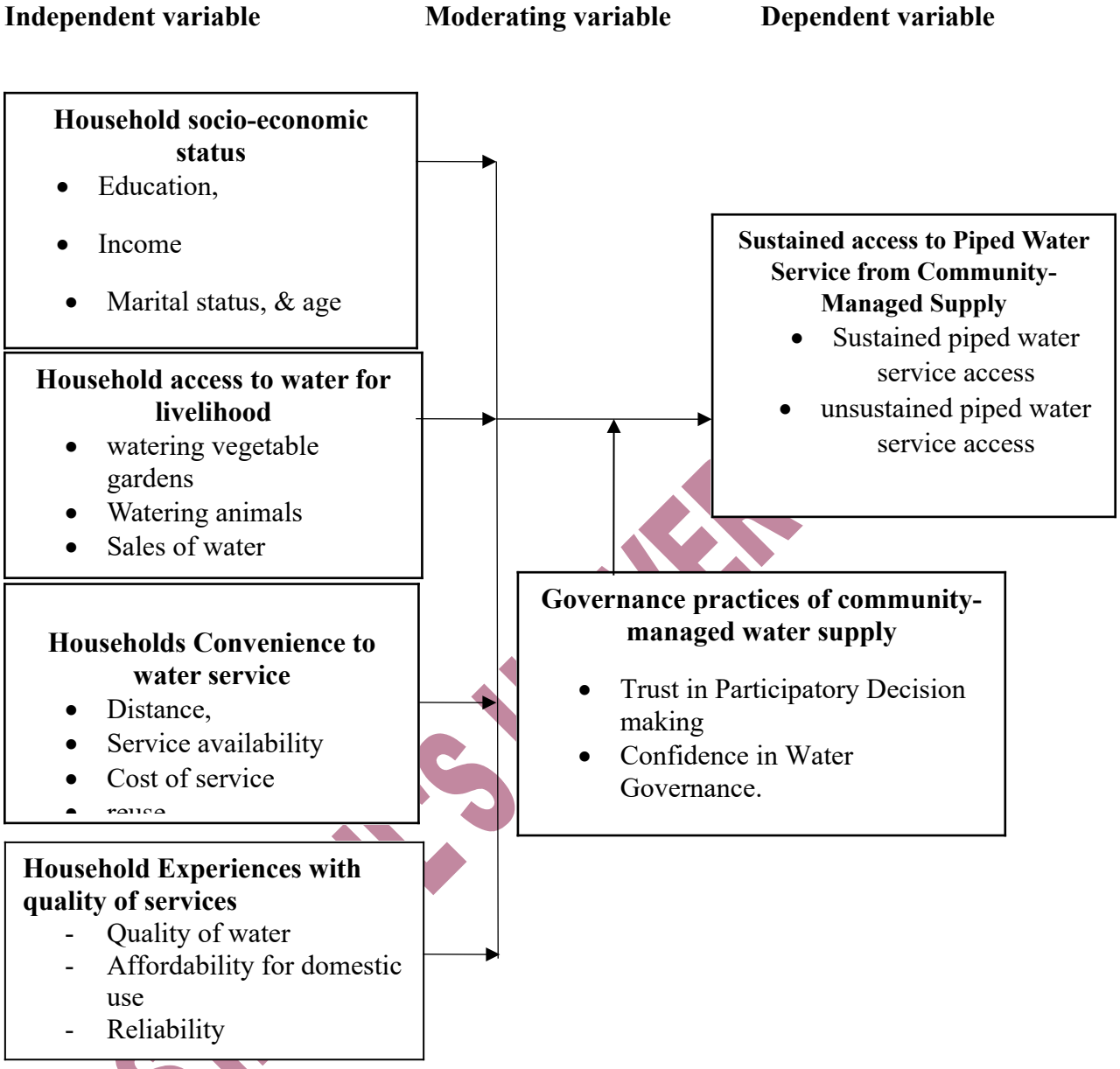


Figure 2. 1: Conceptual framework

The conceptual framework presents the interactions between the independent variables, the intervening variables, and the dependent variables. It diagrammatically relays the information on the investigated associations between the households' and governance factors and the sustained access to water services from a community-managed supply in Nakuru County, Kenya. It illustrates the relationships between household-level factors and the sustainability of community-managed water supply (CMWS). At its core is the understanding that the sustainability of CMWS is a multidimensional construct composed of technical reliability, financial stability, and social equity, each measured through indicators such as service

interruptions, frequencies, revenue collection approach, tariff fairness, access equity, as well as household continued use. It is informed by five key domains of household-level variables: The socio-economic factors that encompass education level, marital status, income source, family size and age of the household head. These factors affect the household's capacity to engage with and support community water initiatives. Secondly, household experiences with CMWS governance practices. The livelihood benefits derived from water use: watering livestock, vegetable production, and selling water for profit. The third domain relates to the conveniences of water services for households and captures physical accessibility and associated costs, which are critical in determining whether households continue to access the CMWS. In addition, household experiences with the water service itself, focusing on water quality, affordability, reliability of piped supply and customer service responsiveness. Lastly, governance was conceptualized as a moderating variable with 2 distinct indicators: trust in participatory decision-making and confidence in water governance. Crucially, to strengthen analytical rigor, the framework incorporates household perceptions of governance as a moderating variable, with a specific focus on trust in participatory decision-making processes and confidence in water governance systems (OECDN 2021). Trust in participatory decision-making was defined as a household's perception that governance of community water systems is fair, transparent and inclusive. Confidence in water governance was conceptualized as residents' belief in the reliability, affordability, and integrity of the water service and the organizations that manage it; moderating variables were posited to influence the strength and direction of the relationships between the independent household-level variables and the sustainability of CMWS. In other words, even where household factors may be favorable or unfavorable, their effect on sustained access to service was significantly shaped by the community's level of trust in governance mechanisms and the degree to which households believe in the legitimacy and functionality of participatory structures. For instance, high trust in participatory decision-making amplifies the positive effects of household engagement, while low confidence in governance dampens households' willingness to support or invest in local water systems, regardless of other enabling factors.

Socio-economic status significantly shapes household participation in the governance of community-managed water services. Households with stable income, higher education, and stable economic capacity are more likely to participate in governance through timely payment of user fees, active meeting participation, contributing to maintenance, and engaging in decision-making. Education increases awareness of collective management and accountability, while income supports financial obligations essential for system

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sustainability. Conversely, households with lower income and less education may be excluded from governance due to financial limitations, lack of confidence, or insufficient understanding of institutional processes. As articulated by Sen (1999) and Nussbaum (2011), the capability approach highlights that resources alone do not ensure well-being unless individuals can translate them into meaningful outcomes. In this study, socio-economic characteristics act as conversion factors that determine household participation and sustained access to piped water through community-managed services.

When households perceive water as safe, reliable, affordable, and consistently available, they are more likely to trust the institution and remain committed to the water systems. Water service quality enhances household confidence in the leadership and encourages continued timely payment, cooperation, and participation. However, when households perceive water quality as poor, unreliable, or too expensive, they are most likely to lose trust in governance structures, leading to reduced participation and eventually disengaging from the services. This interaction supports socio-technical systems theory, which emphasizes that technical service delivery and socio-governance structures function together. Water quality is not only a technical issue but also influences social trust and institutional legitimacy, thereby influencing the sustainability of access to piped water services.

Governance practices are a critical moderating factor in determining households' sustained access to piped water services from community-managed supply. In this study, governance is measured through trust in participatory decision-making and confidence in water governance variables. These factors shape how household characteristics, service experiences, and livelihood dependence translate into long-term access and continued use of piped water services. Governance bridges between household resources and service sustainability. For example, when households have relatively high education and sufficient and stable income, poor governance, weak accountability, lack of transparency, and lack of community participation reduce the user's willingness to remain connected to the system. Consequently, households that rely on water for domestic uses such as farming, livestock, or small businesses may withdraw their support if they perceive leadership is unfair or unresponsive.

Fairly strong governance enhances trust, strengthens institutional legitimacy, improves compliance with contribution requirements, and maintains accountability. Although the community-based natural resource management theory explains this relationship, it also emphasizes the sustainable management of shared resources, which depends on local participation, institutional trust-building, and accountability. Therefore, community–managed

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water systems succeed when users feel represented, engaged, and confident that management decisions are fair and beneficial.

Good governance determines whether technical access, socio-economic capacity, and livelihood dependency can be translated into sustained access to piped water service from community-managed water systems. Governance functions as a socio-conversion factor within the capability Approach and as the institutional foundation within Community-Based Natural Resource Management (CBNRM) Theory and Socio-Technical System Theory. When strong governance is lacking, even well-designed water infrastructure may fail because households lose confidence and disengage from the system. Therefore, sustained access to Community-managed water services depends not only on infrastructure but also on building trusted, accountable, and participatory governance systems. Governance practices function as the moderating variable in the study, determining the strength of the relationship between household socio-economic factors, water services quality, and livelihood dependence on the one hand, and sustained access to piped water services on the other. Where governance is strong, characterized by transparency, accountability, and participatory decision-making, the positive effects of favorable socio- economic conditions and reliable water service on sustained access are strengthened; conversely, weak governance diminishes these effects by reducing trust, lowering compliance with tariff systems, and discouraging continued household participation.

The conceptual framework therefore highlights the complex interplay between household-level determinants and broader governance contexts in shaping the sustainability outcomes of community-managed water supply. It aligns with the principles of participatory development, systems thinking and decentralization, all of which emphasize the necessity of institutional trust and community engagement in achieving long-term water service delivery outcomes. By explicitly integrating governance and institutional trust as moderating variables, the framework offers a more nuanced and realistic depiction of sustainability in a rural water system.

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2.6 Chapter Summary

This chapter featured the theoretical assumptions, which guided this study. It also foregrounded the theoretical and empirical literature, which placed this study in a relevant context and connected it with existing knowledge. The presuppositions guiding this work were those of the capability theory, social-technical system theory and the community-based

natural resource management model. The capability approach was selected due to its significance in explaining how sustained access to community-managed water supply expands household capabilities, particularly in health, time management, food security and income generation. Additionally, the theory informed the first specific objective, which explored the influence of socio-economic factors, and the fifth objective, which assessed the livelihood benefits associated with CMWS use.

The socio-technical system theory complements the analysis of findings by illustrating how the sustainability of community-managed water services is a socio-technical outcome generated through the interaction of the socio-technical and technical infrastructure that support it. The community-based natural resource management model emphasizes local participation, property rights, institutional development, and the devolution of resource management to the community level. It also characterizes people's engagement in preserving their development resources. Local people gain the power to control their future. Thus, conveniences of water services to the population and size of their groupings promote interpersonal communication and lower the cost of decision-making and resource management. Moreover, the chapter synthesized the empirical literature based on all independent variables and their relationship to the dependent variable.

The chapter also elucidated the relationship between the variables of the study in the conceptual framework. In its concluding section, it revealed the knowledge gap that the study intended to fill. The literature provided rich information that formed a solid base for evaluating the factors influencing sustained access to piped water service from community-managed supply in Nakuru County, Kenya.

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CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter delves into the methodology that was used in this study, which was to examine household and governance factors influencing sustained access to piped water services from community-managed water supply systems in Nakuru County. Preliminaries of this chapter expound on the research philosophy that guided that guide the study and the research design employed to achieve the study objectives. The chapter then describes the study area and target population, which is within Nakuru County. Followed by the sampling procedures and sample size determinations used in selecting the study respondents

Further, the study explains the data collection instruments, including the household questionnaire and focus group discussion guide, and outlines the procedures employed during data collection. In addition, the chapter also delineates variable operationalization and measurement of study variables, as well as the pretesting procedures conducted to ensure reliability and validity. Additionally, the chapter also describes data analysis methods, including diagnostic tests and binary regression models used for quantitative analysis, together with qualitative data analysis procedures. Finally, the chapter outlines the institutional access procedure and the ethical considerations observed throughout the study with research participants.

3.2 Research Philosophy

Pragmatism guided this study. It emphasizes practical, real-world outcomes and the use of diverse methods to address complex social problems. Ellis & Hart (2023) describe it as the essential foundation that supports the innate biases of a study and directs the selection of research design. Saunders et al. (2019) stipulate it as a system of beliefs and an assumption on the nature and development of knowledge. Pragmatism as a philosophy originated in the 19th century through the works of Chaarlse Sanders Erir, William James, and John Dewey (Peirce, 1878; James, 1907; Dewey, 1925). The philosophy holds that truth is not absolute but constructed through life experiences and evaluated by its usefulness in solving problems (Beista, 2010). Pragmatism views knowledge as dynamic, context-dependent, and action-oriented, and therefore supports pluralism in research methods. This philosophy is particularly required to address intricate issues such as recurring access by community-managed water supply (CMWS), which has both measurable technical elements and human social activity.

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Pragmatism guides the study's five research goals in a straightforward way. The goals transcend socio-economic factors, households' experience with government, convenience of water services to water sources, the quality of water service, and the livelihood effect. These are descriptive and explanatory ends that require the use of quantitative techniques such as logistic regression and cross-tabulation (such as categorical, continuous, or discrete) and qualitative techniques (such as community experiences and narratives). Pragmatism facilitated this blend, allowing the research to register the depth of household decision-making, service use and access patterns, and institutional nuances of CMWS governance. It also enabled the researcher to adapt the data collection methods in line with emerging field conditions and context-dependent dynamics, as is necessary in rural settings with mixed service delivery.

The theoretical framework of the research focused on five thematic dimensions: socio-economic factors, governance experience, conveniences of water services, service quality, and livelihood benefits. Every area comprised both concrete and intangible elements, such as pipe reliability and distance to the nearest water station, as well as views of governance responsibility and providing customer satisfaction. Pragmatism promoted the integration of different elements using multiple data sources and various methods, as well as validating the statistical evidence and experiential knowledge. It enriched the framework with theoretical constructs from the real world, thereby producing context-sensitive and actionable results. The study's strategy for data processing and interpretation reflects pragmatism. The study used cross-tabulations to investigate preliminary associations and logistic regression to model predictive relationships between household factors and long-term CMWS access and use. In certain instances, independent variables that were not significant during bivariate analysis became relevant in multivariate regression. Pragmatism permitted the interpretation of such events as reflections of social systems' deep complexity rather than conflicts. It supported the employment of complementary methodologies to evaluate data more holistically. In addition, the purposeful decision to focus on households' female heads represents pragmatic thinking because women in rural Kenyan communities are often the primary administrators and users of household water, making their perspectives the most relevant for sustainability research.

The philosophy strengthened the study's applied focus. The goal was not only to generate academic knowledge but also to inform community practice, local governance reforms, and policy interventions that enhance the long-term viability of CMWS. By focusing on "what

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works" in the lived realities of water users and community managers, it ensured that the findings and recommendations of this research are relevant, feasible and responsive to actual field challenges. This contributed to the achievement of SDG 6—ensuring the availability and sustainable management of water and sanitation for all.

Pragmatist philosophy, unlike positivism, emphasizes objective measurement, hypothesis testing, and statistical relationships. Pragmatism allows the study to go beyond numbers and include household perception, governance experiences, and community participation, which are central in understanding sustained access of piped water services. Positivism is limited in explaining subjective issues such as trust in water committees, confidence in governance, and household satisfaction with service quality. Similarly, interpretivism focuses mainly on social meanings and lived experiences but gives less attention to measurable outcomes and predictive analysis required for examining socio-economic factors and service sustainability. This study required employing both quantitative analysis of household characteristics and qualitative understanding of governance practices and users' experiences.

Pragmatism provided the most suitable philosophical foundation by allowing the integration of both approaches to generate practical and policy-relevant findings. Finally, pragmatism was the most suitable and appropriate foundation for the current study due to its flexibility, methodological inclusiveness, and practical emphasis. The philosophy offers an investigation of both the objective and subjective home experiences. It is directly related to the mixed-methods research design, all five objectives of the study, the real-world application of the findings, and the theoretical basis. This approach enhances the study's relevance and utility by addressing the complex, messy, and multidimensional problems of long-term access to services from community-managed supply among rural populations.

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3.3 Research Design

The current study adopted a mixed-method research design. Mixed methods are the type of research in which researchers combine elements of qualitative and quantitative research approaches for the broad purposes of breadth and depth of understanding and corroboration (Daniel, 2016; Mitchell, 2018). The mixed-method approach was justified by the nature and complexity of the research problem, which required both measurement of statistical relationships and an in-depth understanding of contextual experiences that influence sustained access to piped water services from community-managed water

services in Nakuru County. The study problem involves multiple interrelated household and governance factors, such as socio-economic characteristics, livelihood use of water, quality of water service, convenience of water service, and the institutional governance dynamics, which cannot be adequately understood using a single methodological approach.

The quantitative approach was significant in establishing the magnitude, direction, and statistical significance of the relationship among variables affecting sustained access, while the qualitative component was essential in explaining the underlying reasons, perceptions, and contextual realities behind these statistical patterns. Therefore, integrating both approaches enables the study to not only determine what factors influence sustained access but also to explain "how" these factors operate differently across household and community contexts. This complementary nature of the methods ensured a more comprehensive, valid, and community context. This complementary nature of the methods ensured a more comprehensive, valid, and context-sensitive understanding of community-managed water sustainability, thereby directly addressing the multifaceted nature of the research problem.

The study used a cross-sectional survey design in Nakuru County, Kenya. According to Daniel (2016), the cross-sectional research design is one where data are collected from a population sample at a single point in time, thereby enabling examination of the prevalence of a phenomenon or relationship between variables as they naturally exist. The design allowed the collection of data from a population or subset at a single point in time. The design examines the relationship of variables as they exist in a natural setting (Daniel, 2016). The approach was found fitting for the current study because it aims to describe phenomena and determine associations between households, governance factors, and sustained access to piped water services without manipulating the study environment. Unlike the longitudinal design, which requires repeated observations over an extended period, the cross-sectional design was the most appropriate for the study because it made it possible to explain current conditions in water services and allowed the measurement of multiple variables at one point. The method was more feasible in terms of financial resources and logistical constraints while still providing

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reliable evidence for statistical analysis and policy interpretation. These methods were suitable since they facilitated capturing the statistical patterns and contextual and experiential insights of the current status of the community-managed water supply systems and household-level experience of water service sustainability at a specific point in time (Daniel, 2016; Mitchell, 2018). The method combined both the quantitative questionnaires and qualitative focus group discussions. The quantitative component involved a structured questionnaire, which was administered to households to collect measurable data on socio-economic characteristics, service quality perceptions, governance participation, livelihood use of water, and sustained access to community-managed water services.

The methodology allowed statistical analysis, including descriptive statistics and regression modeling, to identify patterns and relationships among the variables. The qualitative component involved a group focus discussion conducted with community-managed water systems users. These discussions provided in-depth insights into lived experiences, perceptions of governance effectiveness, and challenges in service delivery. The qualitative data were essential for explaining statistical patterns observed in the quantitative results, specifically by showing why certain household and governance factors influence access differently across contexts. Integrating both methods allowed for triangulation of the study findings, thereby improving the credibility, validity, and robustness of the results.

Irrespective of the mixed-method and cross-sectional design, the study had some limitations. Since the data were collected at one point in time, the design could not capture the long-term changes in household access to piped water services or establish a causal relationship between household factors and sustained access. The study instead focused on identifying the association and patterns among socio-economic characteristics, governance practices, water service quality, and continued household use of community-managed water systems. The qualitative component helped address the limitation by providing deeper explanations of household experiences, governance challenges, and reasons behind service continuity or disconnection that could not be fully captured through quantitative analysis alone. The quantitative findings from household surveys were compared with qualitative insights from focus group discussions to explain unexpected statistical patterns and strengthen the

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interpretation of results. The integration enhanced the validity of the findings and provided a more complete understanding of how household and governance factors influence sustained access to piped water services in Nakuru County.

Mixed methods approaches are valuable in social and development research because they allow the researcher to capture both measurable trends and contextual meanings of complex phenomena such as water service sustainability. Combining a cross-sectional survey design and a mixed-method approach was appropriate for this study as it allows for simultaneous examination of multiple variables influencing sustained service and governance dynamics in Nakuru County, Kenya.

3.4 Overview of the Study Area

The study focused on Njoro and Murindat Wards, rural and peri-urban areas in Njoro and Gilgil Sub-Counties, respectively. This was based on the premise that water governance in Nakuru County is significantly influenced by the population growth rate as well as institutional flaws, considering that annual rainfall ranges from 669 mm (Nakuru County Government, 2023). As a result, many households depend on rainwater collecting systems, boreholes, protected springs, and small-scale piped networks, mostly managed by local user associations and community-managed organizations. As of the 2023 Nakuru County review, 66% of water supply coverage shared connections and community sources, while 40% relied on unimproved sources. Piped water was available to 36.8% of houses.

The county's water supply is primarily reliant on subterranean water with high fluoride levels. Rainwater collection is another primary source of water in the county, with about 80% of families relying on it (KNBS census 2019 & Mokaya et al., 2016). The County government of Nakuru, through institutional arrangements, has established 248 community-managed water projects. Among the community-managed water projects, approximately 17 serve through the piped-to-household and public water services models, while the rest (231) serve distinctly through the public water services. The community-managed water organizations source water from various sources, including boreholes, rivers, dams, pans, roof catch, and springs, with boreholes being the most predominant source. In contrast, pan and roof catch are the least practiced (CDP, 2023).

The two types of communities differ significantly in terms of household income, access to infrastructure, and population density. The selection of both peri-urban and rural areas in

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Nakuru County was intentional to capture various socio-economic factors that influence households' sustained access to community-managed water services. Rural areas are predominantly agrarian, with low physical infrastructure. At the same time, peri-urban districts function as transitional zones between urban and rural environments, with more diverse livelihoods, higher population density, and rising service expectations (Allen et al., 2006; Tacoli et al., 2015). By combining both environments, the study provides a more thorough understanding and makes its conclusions more relevant across Kenya's many community situations. In rural areas, Nakuru County's water service delivery involves a hybrid strategy that comprises private vendors, community-managed water systems, and public utilities such as NAWASSCO. The latter operate under the Ministry of Water's community project model, which gives local water user organizations (WUAs) management for the water supply, often with little external assistance. Although these programs are essential for rural water access, they suffer several sustainability risks, such as inadequate institutional capacity, inconsistent maintenance, and low accountability.

The semi-arid conditions in some parts of Gilgil Sub-County, specifically Muridat ward, affect the sustainability of community-managed water systems because low and unreliable rainfall reduces groundwater recharge and increases dependence on borehole and seasonal water sources. During the dry season, many boreholes experience reduced yield, resulting in frequent water shortages and increased operational costs. Therefore, households are forced to resort to expensive and unsafe alternative sources such as water vendors or unimproved water points, thereby weakening sustained access to piped water services. The peri-urban setting in Njoro ward creates additional governance challenges due to rapid population growth, informal settlements, and increasing demand for domestic and productive water use. A high population growth rate increases pressure on existing revenue collection, and participation in decision-making is more difficult. These peri-urban dynamics often lead to illegal connections, delayed maintenance, and weak accountability in water committees, thereby affecting both service reliability and household trust in community-managed water systems.

The study was conducted in specific wards (Njoro and Murindat), which enhanced the inclusion of both peri-urban and rural contexts that reflect Kenya's broader socio-economic factors as well as cultural diversities within Nakuru County. By incorporating multiple contexts (peri-urban and rural) that are densely and sparsely populated, the researcher aimed at ensuring variability in the main source of income, education level, service accessibility,

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water access, and user practices. This enhanced the external validity of the findings, thus supporting generalizability of the study results to other regions with comparable demographic and institutional characteristics (Yin, 2018). Nakuru County, particularly Murindat and Njoro Wards, was selected as the research location due to the use and outcomes of CMWS, the variety of water governance models, persistent service dependability issues, and the presence of multiple community-managed systems that have functioned over time with varying degrees of success.

The researcher selected Nakuru County, particularly Gilgil and Njoro wards, as the study area. This was due to their heavy reliance on community-managed water services, which feature diverse governance approaches and service reliability challenges. Furthermore, these wards comprise multiple CMWS that have operated for varying durations and achieved different levels of success. The exclusion of other wards was due to their predominant reliance on the centralized (public utility) and insufficient limitation on governance and performance history. These reasons made them unsuitable for examining the factors that influence sustained access to CMWS (Nakuru County Government, 2023). The county offers a pertinent microcosm for investigating how household-level elements, such as the convenience of water services, socio-economic factors, governance, households' experiences with CMWS quality, experiences with livelihood, and views of governance, influence CMWS's long-term viability.

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3.5 The Target Population

The target population comprised 696 households sourced from the 10 community-managed water projects, which provided piped water arrangements in the selected Sub-counties (Gilgil and Njoro) in Nakuru County. The reason for this choice was based on the need to study those community–managed water projects serving through piped water services. The participants' households were selected based on specific inclusion criteria to ensure relevance to the study objectives.

To begin with, only households with active or previous piped water connections for a community-managed water supply system were selected, since the study focused on sustained access. Further, households were required to have used community-managed water services for a sufficient period to provide significant experiences on service eligibility, governance participation, and livelihood benefits associated with water access. In addition, the study also considered the socio-economic diversity, including differences in income sources and small-

scale farming, to capture varied household experiences. Furthermore, households were categorized based on service continuity, including those with uninterrupted service, those who had experienced disconnections and later reconnected, and finally those who had discontinued use, to examine factors influencing long-term sustained access.

Njoro and Gilgil Sub-counties fitted the inclusion criteria because Gilgil is semi-arid, while Njoro is a watershed, yet the population suffers acute water shortages. These characteristics influence water availability and the continued functionality of the community-managed water supply system. In addition, these wards have rural and peri-urban characteristics that reflect the diversity of Nakuru County. Moreover, they experience contrasting ecological contexts, where Gilgil is semi-arid while Njoro encompasses a watershed. Furthermore, the examination of sustained service access calls for both climatic conditions and resource sufficiency. According to the Nakuru drainage and sanitation master plan (2021), among the 10 selected community-managed water projects, 7 CBOs get water from the borehole; 2 CBOs get water from water springs, and 1 CBO gets water from a river, as indicated in Table 3.1 below.

Table 3. 1: Targeted Piped-to-households Beneficiaries (water users)

Sub-county	**community service provider**	**Water source type**	**Number of households with piped connections**
Gilgil	Ngewacho	Chamuka springs	62
	Karunga	Borehole	48
	Riricua A	Borehole	90
	Riricua B	River	80
Naivasha	Maraigushu	Borehole	80
Njoro	Erithia	Borehole	60
	Ngondu	Borehole	40
	Kihingo	Borehole	56
Subukia	Kianyoro	Borehole	55
	Mubao	Borehole	65
Bahati	Karuga	Spring	60
Totals			**696**

3. 6 Sample Size

3.6.1 Sample Size and Sampling Procedure for Household Surveys

A sample size of 135 households was selected using multistage sampling as guided by the Krejcie and Morgan sampling table (Krejcie & Morgan, 1970), which is most appropriate

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when the population size is known. The sample size of 135 households was considered sufficient for quantitative analysis because it provided adequate representation of the target population and allowed reliable statistical analysis of the study variables. The sample was large enough to support descriptive statistics, bivariate (cross-tabulation), and multivariate (logistic) analysis while maintaining manageable field logistics and resource constraints. In addition, the sample size was determined using the appropriate sampling procedure consistent with social science research standards, ensuring that selected respondents adequately reflected the characteristics of the study population.

A multistage sampling process was employed to ensure that households with different experiences of community-managed water services were adequately represented. Consequently, a two-stage stratified sampling strategy was employed to enhance representation across both service access and geographical dimensions. In the first stage, the three water projects' areas (Erithia, Karunga, and Ngewacho) were purposively selected because they provided household piped water services and reflected both peri-urban and rural settings with different ecological and governance characteristics. These areas served as primary strata that allowed the research to capture most potential context differences in the community-managed water services implementation. In the second stage, the households within each project area were further stratified according to their piped-water connection status (Never disconnected, disconnected but later reconnected, and disconnected but never reconnected). This categorization was fundamental because sustained access could only be properly understood by comparing households with different service continuity experiences. This categorization was fundamental because sustained access could only be properly understood by comparing households with different service continuity experiences.

The researcher created separate lists for each connection status stratum. The first stratum comprised of households that had never been disconnected from the main pipe since the initial connection. The second stratum included households that experienced disconnection at least once, but were later reconnected and continued to have access to water services. The third stratum comprised households that were disconnected and never reconnected, which means they no longer receive water services from a community-managed water supply. The approach ensured that all households, including the disconnected or never reconnected households, were included in the study.

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After stratification, proportionate sampling was employed to ensure that each category contributed fairly to the final sample based on its population size. The researcher ensured that each household fell into only one category since the strata were fully distinct and not overlapping. This approach ensured that geographical context and service continuity were represented in the sample while maintaining mutually exclusive strata. Lastly, simple random sampling using household registers and random number tables was used to select observational units from each stratum, thereby reducing selection bias. The researcher employed random selection of respondents from each stratum, using water project registers and random number tables. This approach reduced choice and coverage biases; thereafter, random number tables were used to select participants from the water project list of water users, giving every participant an equal chance in the study (Chakrabarty, 2017).

Table 3. 2: Population, expected proportional sample, actual sample and sampling weights

Project area & connection status	**Population (N)**	**Expected proportional sample*(Ncell/Ntotal×135)***	**Actual sample size (n)**	**Weight(W=N/n)**
Never disconnected				
Ngewacho	32	25.26	25	1.28
Erithia	35	27.96	30	1.17
Karunga	27	21.57	20	1.35
Disconnected-reconnected				
Ngewacho	10	7.99	8	1.25
Erithia	12	9.59	10	1.20
Karunga	8	6.39	7	1.14
Disconnected –never reconnected				
Ngewacho	20	15.98	14	1.43
Erithia	12	9.59	10	1,20
Karunga	13	10.38	11	1.18
TOTAL	169	135	135	

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3.6.2 Recruitment of Participants for Focus Group Discussions

Purposive sampling was used to select participants for the FGDs. Recruitment criteria included participants with diverse experiences with community-managed services, such as participation during pipe installation, sources of materials, experiences with water service provision, and different kinds of service disruption from community-managed supply, including disconnection and reconnection. 60 participants were recruited to participate in the FGDs. There were three FGDs for each of the two community-managed water supply

projects, namely, women who had never experienced disconnection, women from households that had experienced a disconnection of services but reconnected, and women from households that had never been disconnected.

Qualitative informants were considered adequate because qualitative research emphasizes depth of information rather than large numbers. The group discussions were designed to capture diverse experiences, perceptions, and insights regarding community-managed water services. The selected observational units provided rich and contextual data, and the number was adequate to achieve data saturation, where no substantially new themes or perspectives were emerging. Therefore, the sample size was adequate to ensure credible and comprehensive qualitative findings.

3.7 Data Collection Instruments

Data were collected using two instruments: a questionnaire and a focus group discussion guide. The use of multiple instruments was informed by the mixed-methods design, which required both numerical measurement of variables and contextual understanding of household experience with community-managed water supply systems.

3.7.1 Questionnaire

The questionnaire was developed based on the study objectives and operationalized key study variables including household socio-economic characteristics, governance participation, water service convenience, perceived quality of water services, livelihood use of water, and sustained access to community-managed water supply systems. Specifically, the instrument captured data on indicators such as household income levels, education status, distance to water points, reliability of supply, affordability of services, and participation in water committees.

Data were gathered through an open-ended and closed-ended questionnaire. The questionnaire covered the data for the independent variables: section A covered the water service models and household socio-economic factors; section B addressed the livelihood outcomes and sustained access patterns; section C examined the conveniences of water services; while section D covered household experiences with quality of community-managed water services, and perceptions of livelihood, and governance practises.

The choice of the questionnaire was justified by its ability to generate standardized data that could be statistically analyzed to determine the relationship between independent and

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dependent variables as moderated by governance practices. The questionnaire enhanced efficient data collection from a relatively large sample within a limited time frame, thereby improving the comparability of the responses across households. The supervisor reviewed the questionnaire to ensure content relevance, validity, clarity, and alignment with the research objectives. Reliability of the questionnaire was improved through piloting the instrument in Subukia Constituency, Waseges Ward, which has a similar but non-sampled population, and necessary adjustments were made to improve the clarity and consistency of the questions.

3.7.2 Focus Group Discussion (FGD) Guide

A semi-structured interview guide was used to collect data from the sample of FGD participants. The tool is flexible in guiding the conversation and allows the researcher further probing as well as asking follow-up questions and exploring new themes that arise during the interview. Three FGDs were conducted from every CBO that comprised: FGD for households who never got disconnected from the community-managed piped water service; FGD from the households who got disconnected and later connected back to community-managed piped water services; and FGD from the households that, when disconnected, never got reconnected to the community-managed piped water service.

Data collected included multiple water sources, economic benefits to women, storage practices, seasonality effects, and the significance of governance as a (moderating variable), as well as sustained household dependence on community water service for domestic uses. The importance of the FGD as recommended by (2017) and Mishra in this study was to solicit information by bringing those who have experienced challenges in their access to water service. The process included the uncovering of the respondents' perceptions, attitudes, beliefs and opinions. The clarity and understanding of unmet needs, as well as addressed issues, influenced county policy formulation.

3.7.3 Measures to Mitigate Recall and Social Desirability Bias

While pretesting of the research tools fundamentally enhanced identification and correction of questions that could trigger recall or social desirability bias, the research included additional measures during the actual data collection. The measures included research assistants' training, neutral wording, and reducing the recall time. This technique increased the integrity of the data collection tool and the data collected. Considering the nature of rural and peri-urban households and the water systems governance–related data, measures were taken to reduce social desirability biases. To mitigate recall bias, the researcher limited the

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recall period to less than 5 months, ensuring that the questions were explicitly tied to a local and recognizable event (long rains and dry seasons).

The researcher triangulated the methods using the community-managed water services management committee records to validate the responses (Tourangeau, Rips, & Rasinski, 2000). The researcher carefully worded the questionnaire to minimize the possibility of social desirability and to avoid judgmental intonations. In addition, he conducted interviews privately. The research assistants and enumerators were trained in neutral communication and confidentiality protocols. Respondents were assured of anonymity to encourage truthful disclosure when necessary; indirect questioning was used.

3.8 Data Collection Instruments' Pre-Testing

Before the actual data collection, a pre-test on the research instruments was conducted through a pilot study. Although the rule of thumb recommends a 10% pilot sample, the study comprised multiple variables (socio-economic, livelihood, convenience, service quality, and governance practices); therefore, a larger sample was used to enhance reliability and stability of the questionnaire. A larger sample size reduces the possibility of overlooking ambiguous questions and provides a better estimate of potential response variability.

The pre-test was conducted among 60 households in Waseges ward in Subukia Sub-county, who were not included in the study. The 60 households that participated in the pilot test were selected to reflect similar socio-economic and water services characteristics as the main study population, including both the rural and peri-urban settings. The participants were drawn from community-managed water user households who experienced piped water services. After the questionnaire administration, feedback was collected through brief follow–up discussions and direct probing questions, where respondents were asked to highlight unclear questions, confusing wording, and sensitive items they felt uncomfortable answering. The researcher also observed the response time. Skipped questions and hesitation patterns during the administration process were observed to identify potential issues in question design and sequencing.

Pre-test enhances coherence on the items in the research tool and provides the expected respondents' understanding of the questions, therefore making the most out of it (Holland & Piper, 2016). Should there be inconsistencies in the questions, such as in the follow-up questions, the pre-test is of significant help. Through the pre-test activity, the researcher was able to determine the questions' intelligibility to the respondents. Additionally, the researcher was able to identify the most sensitive questions, extract them, and remove the double-

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barrelled ones to eliminate possibilities of misinterpretation. The researcher also ascertained consistency through the skip pattern questions. Further, among the categorical questions where respondents select others, the researcher sought other overlooked choices and adjusted the questionnaire by adding these options.

Misinterpreted and double-barreled questions in the survey were restated accordingly. The researcher established the sensitive questions and avoided them in the final questionnaire. Inconsistent scales identified were also adjusted accordingly. Based on the pretest feedback, several refinements were made to improve the clarity and measurement accuracy of the research instruments. Ambiguous questions related to governance participation and tariff payment were reworded to enhance clarity and reduce misinterpretation. Sensitive questions were adjusted to improve logical flow, particularly by placing general household information before the governance and service quality section. Ski patterns were also corrected to ensure smooth navigation of follow-up questions, and additional response options were included in categorical items where respondents had indicated missing choices during the pilot test.

The study employed a latent variable measurement framework, where constructs were operationalized using multiple observed indicators. To evaluate the adequacy of these measures, both validity and reliability were assessed using confirmatory factor analysis and Cronbach's alpha measure of internal consistency as presented in .

Table 3. 3: Validity and Reliability Assessment of Study Constructs

Construct (Role)	Item Code	Factor Loading (λ)	AVE	CR	Cronbach's α
Water Service–Sustained access to Service (Dependent)	ws_sust_now	0.874	0.762	0.906	0.905
	ws_sust_1m	0.903			
	ws_sust_3m	0.846			
Access to Water for Livelihood (Independent)	wl_access_livestock	0.729	0.553	0.831	0.760
	wl_access_animdry	0.774			
	wl_access_veg	0.747			
	wl_access_sell	0.711			
Convenience of Water Service (Independent)	ws_conv_dist	0.756	0.617	0.829	0.793
	ws_conv_avail	0.820			
	ws_conv_cost	0.783			
Quality of Water Service (Independent)	ws_qual_selfrep	0.838	0.692	0.871	0.854
	ws_qual_afford	0.792			
	ws_qual_reliable	0.856			
Trust in Participatory Decision-Making (Moderating)	tpdm_trust_proc	0.847	0.676	0.912	0.824
	tpdm_voice	0.883			
	tpdm_fairness	0.865			
	tpdm_inclusion	0.729			

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	tpdm_feedback	0.856			
Confidence in Water Governance (Moderating)	wg_conf_lead	0.901	0.731	0.947	0.882
	wg_conf_account	0.838			
	wg_conf_transp	0.865			
	wg_conf_service	0.883			
	wg_conf_policy	0.847			
	wg_conf_integrity	0.874			
	wg_conf_respons	0.829			

3.8.1 Convergent Validity

According to Csikszentmihalyi & Larson (2014), validity refers to the extent to which the instrument or the method measures what is intended to measure, as well as the relevancy and accuracy of the interpretations of the research results. The researcher checked if the questions in the questionnaire and the interview guide measured accurately what they were intended to measure. The researcher used convergent validity to illustrate the extent of concurrency and the interrelationship among the different steps of the construct. Convergent validity describes the extent to which items intended to measure the same construct are strongly related. Holland and Piper (2016) state that convergent validity seeks to measure the minimum correlation between the measurements of the different constructs. This was assessed using factor loadings (λ) from Confirmatory Factor Analysis (CFA) and Average Variance Extracted (AVE) as presented in . Factor loadings represent the strength of the relationship between each observed item and its underlying latent construct. A commonly accepted threshold is $\lambda \geq 0.50$, although more stringent standards recommend $\lambda \geq 0.70$ for well-established constructs (Hair et al., 2010). In this study, all factor loadings exceeded 0.6, indicating that each item contributed meaningfully to its respective construct.

AVE measures the proportion of variance captured by a construct relative to measurement error. An AVE value of 0.50 or higher indicates adequate convergent validity. As shown in , all constructs achieved AVE values ranging from 0.553 to 0.762. This confirms that the constructs explain more than half of the variance in their indicators. The researcher checked if the questions in the questionnaire and the interview guide measured accurately what they were intended to measure. The study validated the research tool, as none of the previous studies demonstrated validity enhancement among the reviewed journals.

3.8.2 Internal Consistency Reliability

According to Middleton (2025), reliability of the data collection instrument includes stability and consistency of a measure, indicating minimal measurement error. Reliability assesses the

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consistency of measurement across items within a construct (Sudyasjayanti, 2018; Taherdoost, 2016; Golafshani, 2015). Two complementary indices were used: Cronbach's alpha and composite reliability. Cronbach's alpha evaluates the internal consistency of items within a scale. A threshold of $\alpha \geq 0.70$ is generally considered acceptable, while values above 0.80 indicate good reliability (Nunnally & Bernstein, 1994). This method gives an alpha value for each scale, which is compared with a pre-determined threshold often set at 0.7 (Chen et al., 2013). In this study, alpha values ranged from 0.760 to 0.905, demonstrating satisfactory to excellent internal consistency across all constructs. A pre-test of the research instrument was conducted among 60 households to assess its reliability and clarity.

With the help of the Statistical Package for the Social Sciences (SPSS, 30), the researcher computed Cronbach's alpha independently for each of the study constructs. According to Nunnally and Bernstein (1994), this indicated that all the study constructs met the recommended reliability threshold $\alpha \geq 0.70$. Composite reliability provides a more precise estimate of internal consistency by accounting for the actual factor loadings of items. A threshold of CR $\geq$ 0.70 is recommended (Hair et al., 2010). The CR values in this study ranged from 0.829 to 0.947, indicating strong reliability of all latent constructs.

3.9 Data Analysis and Presentation

Qualitative data were analyzed using content analysis, while quantitative data were analyzed using both descriptive and inferential statistics. After the questionnaires were collected and screened for any discrepancies, the data were coded and edited to ensure their comprehensiveness and accuracy.

To control overlapping variables, especially in the socio-economic factors, governance, and experiences with water services domains, the research employed theoretical separation and statistical validation techniques. During the construction of composite indices, factor analysis was applied to enhance variable loading onto distinct components. Further, multicollinearity diagnostics ensured that no redundancy existed among the explanatory variables. Despite the community-managed system being expected to show interdependency, it was analytically structured into separate dimensions informed by governance and sustainability.

The dependent variable in this study was Sustained access to Piped Water Service from Community-Managed Supply. This variable refers to household continued reliable access to piped household water services. Sustainable access was measured as a binary outcome variable coded as 1 for households reporting sustained access, and 0 for households reporting unsustained access. The

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definition of this variable was anchored on household-level access to piped water supplied through community-managed systems. The study focused on households with piped water. The respondents were asked such questions as, "If your household has piped water, is the water running NOW?", "If your household has piped water, has the water been running for the last one month?" and "If your household has piped water, has the water been running for the last three months?" To create a single indicator, Y (0 or 1) was applied. If the answer was "yes," then the household was categorized as service sustainable, and the indicator for the dependent variable used was consistent with the goal: household capacity to sustain community-managed water supply.

There were five independent variables: household socio-economic factors, governance practices, convenience of water services, household perceptions of quality of CMWS, and experiences with livelihood. The socio-economic characteristics were assessed using the following indicators: education level, employment status, marital status, family size, and age. These variables were collected as numerical figures to assess their association with household capacity to sustain water services. Governance of service was assessed by establishing whether the household was in the urban or rural setup, as well as the actual revenue collection (active/ proactive), Accountability, maintenance, cost of supply, and supply coverage. The variable data was collected in both figure and thematic forms. The households' convenience of water services to the main pipe and the water source were measured in terms of distance to the source, time taken, availability, cost of service, quantity, repairs and replacement of components.

Respondents were expected to report the time taken from the tap or water source to the house, the cost to the household, the quantity of water available, and who was responsible for service. Additionally, on the household perceptions of quality, CMWS was used to assess the opinion the household held about the water for their household, water treatment if there was doubt about water, affordability for domestic use (was the household able to afford the services?), how reliable was the service and how each household handled water from the source? Perceptions on livelihood were measured by establishing whether the household kept livestock, watered vegetables, watered their livestock, and sold water to neighbors for profit in relationship with the household ability in sustaining the community-managed water supply. If the answer was "yes", then the member of the household who benefited the most had to be singled out. On food security, the respondents were expected to establish whether they in anyway used the water to grow vegetables or water their livestock. On income, the

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respondents had to establish if the water was used as a source of income by selling it to neighbors and, if "Yes", how much per 20 liters.

The study adopted a binary logistic regression to examine the likelihood of sustained access to piped water services from community-managed systems. The dependent variable (Y) was sustained access to piped water services, coded as 1 = sustained access and 0 = unsustained access. The model tested the effect of five predictor variable groups: socio-economic factors (X_1), Livelihood use of water (X_2), convenience of water services (X_3), perceived quality of water service (X_4), and governance-related factors (X_5).

The baseline model was specified as: $Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \varepsilon$

To assess moderation effects, interaction terms between governance variables (trust in participatory decision-making and confidence in water governance) and each predictor variable group were introduced into extended models. Further, the significance of the coefficient was assessed using the P-value ($p < 0.05$) and the odds ratio to determine the strength and direction of associations.

Integration of the qualitative and quantitative study findings was conducted during the interpretation and discussion phase using a triangulation approach. The quantitative results from the logistic regression provided statistical evidence on the magnitude and direction of relationships between household-level factors and sustained access to water service. In contrast, the qualitative results from the focus group discussion provided contextual explanations for these statistical patterns by capturing lived experiences, perceptions, and institutional dynamics that influence water access.

These two data sets were merged at the interpretation stage through a side-by-side comparison approach, in which qualitative themes were used to explain, confirm, or expand quantitative findings. For example, a statistically significant association between governance trust and sustained access was further explained by qualitative evidence highlighting perception of fairness, transparency, and accountability in water committees. Similarly, non-significant variables in the regression model were explored qualitatively to understand contextual or structural reasons for their limited statistical influence. Therefore, this integration approach enhances complementarity between numerical trends and lived experiences, thereby enhancing the validity, depth, and policy relevance of the study results.

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3.9.0 Operationalization of Study Variables

3.9.1 Dependent Variable- Household Sustained Access to Piped Water Service

Sustained access to piped water service was conceptualized as the consistency and continuity of piped water supply at the household level over time. It captures whether water is not only available at a single point but sustained across short and extended periods. This construct was measured using three binary items: whether water was running at the time of the survey *(ws_sust_now),* whether it had been running over the past month (*ws_sust_1m*), and whether it had been running over the past three months (*ws_sust_3m*). These items reflect immediate, short-term, and medium-term service stability. A composite index was generated using Principal Component Analysis (PCA). The first principal component was retained as it explained the largest proportion of variance. The resulting continuous score was dichotomized using zero as a threshold: values above zero indicated sustained access (1), and values below zero indicated unsustained access (0). This approach captures both the persistence and reliability of water service delivery.

3.9.2 Independent Variable

a) Access to Water for Livelihood

Access to water for livelihood was defined as the extent to which households utilize water for productive and income-generating activities. This construct reflects the role of water beyond domestic consumption, particularly in supporting rural livelihoods. It was measured using four binary indicators: whether the household keeps livestock (*wl_access_livestock*), whether it waters animals during dry seasons (*wl_access_animdry*), whether it waters vegetables (*wl_access_veg*), and whether it sells piped water for income (*wl_access_sell*). These items capture both subsistence and commercial uses of water. A composite index was derived using Principal Component Analysis (PCA), which aggregates the shared variance across these indicators into a single score representing livelihood-oriented water access.

b) Convenience of Water Service

Convenience of water service was conceptualized as the ease with which households can access and use water services. It reflects physical accessibility, service availability, and economic burden. This construct was measured using three indicators: distance to the water source (*ws_conv_dist*), perceived availability of water service (*ws_conv_avail*), and cost of accessing water (*ws_conv_cost*). These indicators collectively capture spatial, temporal, and

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financial dimensions of convenience. A composite variable was constructed by aggregating these items, and scores were standardized using z-scores to allow comparability across respondents. Higher values indicate greater convenience in accessing water services.

c) Quality of Water Service

Quality of water service was defined as households' perceived experience of the safety, reliability, and affordability of piped water supply. It captures both subjective evaluation and functional performance of the service. This construct was measured using three indicators: self-reported water quality (*ws_qual_selfrep*), affordability for domestic use (*ws_qual_afford*), and reliability of piped water (*ws_qual_reliable*). These items reflect experiential, economic, and operational aspects of service quality. A composite index was generated by combining these indicators, with higher values representing better perceived service quality.

3.9.3 Moderating Variable

a) Trust in Participatory Decision-Making

Trust in participatory decision-making was conceptualized as the degree to which households perceive water governance processes as inclusive, fair, and responsive to community input. This construct reflects confidence in the participatory nature of decision-making structures within community-managed water systems. It was measured using five Likert-scale items: trust in the decision-making process (*tpdm_trust_proc*), perception that community voices are heard (*tpdm_voice*), perceived fairness of participation (*tpdm_fairness*), inclusiveness of stakeholders (*tpdm_inclusion*), and the extent to which feedback is considered (*tpdm_feedback*). Responses were aggregated into a composite score after appropriate coding. Higher values indicate greater trust in participatory governance. This variable was included as a moderator to assess whether participatory trust conditions the relationship between service factors and sustainability outcomes.

b) Confidence in Water Governance

Confidence in water governance refers to households' belief in the effectiveness, transparency, and integrity of institutions responsible for managing water services. It captures perceptions of institutional performance and accountability. This construct was measured using seven Likert-scale items: confidence in leadership (*wg_conf_lead*), accountability (*wg_conf_account*), transparency (*wg_conf_transp*), service delivery capacity

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(*wg_conf_service*), policy effectiveness (*wg_conf_policy*), integrity of officials (*wg_conf_integrity*), and responsiveness to community needs (*wg_conf_respons*). These items collectively reflect multiple dimensions of governance quality. A composite score was computed by aggregating the items, with higher values indicating stronger confidence in governance systems. This variable was modeled as a moderator to examine how institutional trust shapes the effect of service characteristics on sustained access.

3.9.4 Household Socio-economic Factors on Sustained Access to Piped Water from Community-Managed Water Supply

The first objective of the study was to assess the association of household socio-economic status on sustained access to service from community-managed water supply. To address this objective, the researcher formulated two sequential logistic models. Regression analysis model one in question three summarized the relationship between household socio-economic factors and the community-managed supply. The measurement characteristics were education level and employment status. Model 2 presents the regression results of Model 1 after adding marital status. Model 3 shows the effects of Model 2 after adding factors such as family size and age.

3.9.5 Access to Water for Livelihood on Sustained access to piped water from community-managed water supply

In responding to the question, the researcher formulated two sequential logistic models. Model one in question three summarized the relationship between livelihood characteristics enhanced by water services models and sustained water service use. The measured characteristic was households keeping livestock. Model two presents the regression results of model one after adding watering of vegetables. Model three shows the effects of model two after adding factors such as selling water to neighbors.

3.9.6 Convenience of Service on Sustained Access to Piped Water from Community-Managed Water Supply

To answer this question, the researcher formulated two sequential logistic models. Model one summarizes the relationship between the water service model's conveniences of water services and sustained water service use. The measurement characteristics were distance to the source and the time taken. Model two presents the regression results of model one after adding service availability. Model three shows the effects of model two after adding factors such as cost of service, quantity, repairs and replacement of components accessed quantity.

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3.9.7 Quality of Water Service on Sustained access to piped water from community-managed water supply

Answering the question, the researcher formulated two sequential logistic models. Model one in question three summarizes the relationship between quality of the water service and sustained access to water service from a community-managed supply. The measurement characteristics were quality of water and affordability for domestic use. Model two presents the regression results of model one after adding reliability. Model three shows the effects of model two after adding factors such as quality of service, water source, and water handling.

3.9.8 Moderation Effects of Governance Practices on the Relationship Between Household and Governance Factors on Sustained Access to Piped Water from Community-Managed Water Supply

In addition to the above regression models, the influence of the moderating variable, which is the governance characteristics of the water supply model, trust, accountability, and transparency, was analyzed for each of the above 4 variables. The analysis of the variables facilitates an understanding of the influence that the water service governance factors have over the relationship between sustained access to service and each water service model's arrangements.

3.10 Qualitative Data Analysis

After conducting the discussions with the 60 women households on their perceptions of the factors associated with sustained access to water service from community-managed supply, data analysis was conducted. The qualitative data analysis was conducted using the six-phase thematic analysis framework proposed by Braun and Clarke's (2006), with NVivo 15 (trial version) supporting the coding process. This approach was selected for its flexibility in identifying, analyzing, and reporting patterns within the qualitative data. The six-phase process involved the following:

Familiarization with the data

All six focus group discussions (FGDs) were transcribed verbatim. The transcripts were read and re-read carefully to understand the content and gain an initial understanding of the general scope of the data. During this phase, preliminary observations were noted, such as the recurring emphasis on consequences of water disconnections, financial sacrifices to afford reconnections, and the prominent role of women in managing household water needs.

Generating initial codes

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In this phase, all the FGDs were merged into one file and imported into NVivo. The "*auto code*" function was used to generate preliminary codes based on a content analysis algorithm. this was followed by manual inspection using an inductive approach. Open coding was performed across the entire dataset to generate short descriptive codes summarizing key features of the data. Examples of initial codes included physical burden of water fetching, taking loans for reconnection, water scarcity affecting hygiene, women attending water project meetings, low water pressure, and rainwater harvesting. The manual inspection of the auto-coded initial codes from NVivo was done to ensure sensitivity to different meanings without being constrained by software output.

Searching for themes

The initial codes from the second phase were then collated into broader potential themes by clustering related codes together. For instance, codes like "physical burden", "back pain", and "long distance to river" were grouped into a general theme "Water accessibility challenges". Codes like "loans from Chama", "selling chicken", and "paying ditch digging labour" were merged under a general theme of "Financial burden and contributions for access". Repeated mentions of "women fetching water", "girls' safety improved", and "women most affected by disconnection" clustered into "Gendered impact and responsibilities". In this phase, the initial thematic map began to form, visually organizing how themes related to each other.

Reviewing themes

Each potential theme identified in the third phase was reviewed against the coded extracts and the entire dataset to ensure consistency and meaningfulness. Some preliminary themes were refined, split, or merged. For instance, "Community solidarity" became its own theme after recognizing strong support behaviors like group ditch digging and neighbor help. Similarly, "Service delays and bureaucracy" emerged as an important addition after reviewing how often delays and frustrations with reconnections were mentioned. The purpose of this phase is to ensure all themes were distinct and coherent enough to serve as an independent report of the fieldwork.

Defining and naming themes

In this phase, clear definitions were developed for each theme that summarise the essence of what each captured. The finalized themes were Water accessibility challenges, financial burden and contributions for access, Gendered impact and responsibilities, Perceived benefits of water reconnection and community solidarity and self-help. Each theme was accompanied

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by thick descriptions, including representative quotes from participants, to ensure that the findings are grounded in their voices.

Producing the report

According to Braun and Clarke's (2006), the final stage in the thematic analysis framework is to draft a coherent narrative report. However, since this study adopted a mixed-method approach, this final stage was adjusted by presenting the findings into thematic sections structured within the statistical results from the quantitative analysis. Qualitative data were synthesized and integrated to align with different aspects of the statistical results. This was followed by direct storytelling-style quotes to illustrate participants' perspectives. For example:

> *"When asked who is most affected when water is disconnected, women across all FGDs unanimously stated it was them. One participant captured the sentiment saying: 'I must figure out how our children will bathe, how I will cook, and what my husband will drink… everything is on us.'" (FGD4)*

This presentation style was based on a triangulation approach that provides a rich and contextual cognizance of the survey.

3.11 Ethical Consideration

The researcher obtained the approvals and clearance certificates from the responsible institutions for the study. Although the researcher engaged the area administration, the institutional access procedures were followed before entering the study area and engaging participants. In addition to obtaining the ethical clearance from the university, the St Paul's University Ethical Review Board (SPU-ERB), and research authorization from the National Commission of Science and Technology NACOSTI, the researcher also informed the relevant authority, as well as stakeholders such as NAWAASCO and NARUWASCO. For the chiefs and water bodies' representatives whose work facilitated community entry, written authorization was not obtained, the reason being that the study was authorized both by NACOSTI, a body that is recognized by all levels of administration as a legal and sufficient authority. Typically, the area chiefs provided only verbal clearance after the researcher deposited the research objectives for verification. Consent of the research participants, where they had to decide whether they agreed to participate in the study, was sought. For security purposes, the researcher ensured the anonymity of the participants, in that the participants were not identifiable by name. Privacy was maintained by the information provided not being shared. Informed consent was obtained from all participants before data collection. Every

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respondent was provided with enough information regarding the purpose of the study, the nature of participation, the expected duration of the exercise, and the relevance of the research to the sustainability of community-managed water services.

The respondents were informed that their involvement in the study was entirely voluntary and that they had the right to participate or withdraw from the study at any stage without any penalty, intimidation, or experiencing any negative consequences. During the data collection, informed consent was sought from all the participants. For the respondents who could read, written consent forms were provided and signed before participation. For the respondents whose literacy was disadvantaged, the consent information was read to them in Kiswahili and Kikuyu, depending on the respondent's preference, and verbal consent was obtained as proof of agreement. This exercise enhanced inclusivity and comprehension across all respondents. Additionally, the principle of do no harm was upheld in the study by ensuring that all the respondents were protected from physical and psychological harm by not asking questions that could cause distress or shock the participants. Furthermore, the data collected was not disclosed to other respondents. Consequently, the data collected for the writing of this thesis were collected from respondents but not attributed to any specific participants. Further, the sources for cited works in the study were referenced.

To enhance privacy during data collection, questionnaires were administered in a manner that allowed participants to provide independent responses without interference or influence from external participants. The focus group discussions were conducted in a secure, neutral, and comfortable environment that enhanced open discussion and protected participants from unnecessary exposure or social discomfort. The researcher ensured respectful and professional conduct during discussions that created a safe atmosphere where participants could freely express their views, experiences, and concerns regarding water service delivery without fear of victimization or discrimination.

By ensuring that respondents were protected from any physical, emotional, psychological, and social harm throughout the research process. The researcher removed any question that could have caused emotional distress, discomfort, or personal embarrassment. In case the respondents appeared uncomfortable during the data collection, they were allowed to skip the questions or discontinue participating without explanation. The approach safeguarded the wellbeing and dignity of all respondents during the study.

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Data confidentiality and security were strictly maintained throughout the study. The completed questionnaire was securely stored, while electronic data such as audio recordings and transcripts were protected using password-secured files that were only accessible to the researcher and the academic supervisor. personal identifiers such as names or personal contact were not included in the final dataset to maintain to maintain anonymity. The collected data were strictly for academic purposes; therefore, they were not shared with unauthorized people or institutions. After the completion of the study and the university examination requirements, hardcopy materials will be securely destroyed and electronic files permanently deleted to prevent misuse or unauthorized access.

The principles of beneficence and justice were also observed in the data collection process. This was achieved by ensuring the study findings would contribute to improved policy framework, strengthened governance structures, and better management of community-managed water services, benefiting households and communities that depend on such systems. Justice was upheld by ensuring fairness and equality in participant selection and treatment. All eligible participants received equal opportunity to participate in the study without discrimination based on age, gender, marital status, socio-economic status, or socio-position.

3.12 Chapter Summary

This chapter presented the research methodology applied in the study. It highlighted the research philosophy of pragmatism, which underpinned the study. Moreover, it featured the rationale for the adoption of the same and the research design that informed the study as well as the quantitative and qualitative methods used. The mixed-methods approach enabled the researcher to address the research questions appropriately and provided a more holistic perspective. More details on sampling techniques are in the chapter concerned. With a target population of 696 households from the 10 community-managed water projects in Gilgil and Njoro Sub-counties of Nakuru County, 135 households were selected using multistage sampling. Purposive sampling was used to select 60 participants for the focus group discussions. Over and above that, the chapter advanced on instruments for data collection, namely, questionnaires and interview guides, as well as on the reliability and validity of the instruments as shown in the findings of the pilot study conducted. Finally, it commented on data processing and analysis procedures adopted and the ethical considerations made in the study.

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CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

This chapter delineates the findings of the entire study. The study examined how various factors affect sustained access to piped water service from a community-managed water supply. This chapter presents findings according to the study's specific objectives. The first section presents findings on household socioeconomic status and its influence on sustained access to piped water service from the community-managed water supply systems. The second section addresses access to water for livelihood and its relationship with sustained access. Further, in the third section, the study presents findings on the convenience of water services, including distance, availability, and cost of service. In the fourth section, the study presents the findings on household perceptions of the quality of community-managed water services, particularly reliability, affordability, and water safety. Finally, in the fifth section, analysis of governance processes as moderating factors focusing on trust in participatory decision-making and confidence in water governance is presented. The quantitative study findings are complemented by qualitative findings from focus group discussions to provide deeper contextual understanding of household experiences and governance dynamics within community-managed water systems.

The study targeted 135 households' respondents for the quantitative survey using a structured questionnaire. Out of 135 respondents, only 130(96.3%) completed and returned. Among the 60 FGD selected participants, all participated successfully, translating to a 100% response rate. According to Mugenda and Mugenda (2003), a response rate of 50% is adequate, while 60% is good, but above 70% is considered very good for research studies. Therefore, the response achieved in this study was excellent and sufficient for reliable data analysis and generalization.

4.2 Household Access to Water Services in the Community-Managed Systems in Nakuru County

The data in bar chart 4.3 provides valuable insights into the complex interplay between household behavior and governance quality in determining the sustainability of community-managed water services. While overall connection retention is commendable at nearly 70%, the notable percentage of disconnections and permanent dropouts signal that systemic issues remain. These include water source challenges, weak governance in some areas, and socioeconomic barriers at the household level. Going forward, strengthening community

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governance structures, improving transparency and responsiveness, and investing in sustainable infrastructure, particularly borehole systems, will be critical to ensuring that piped water services not only reach households but are also maintained sustainably over time.

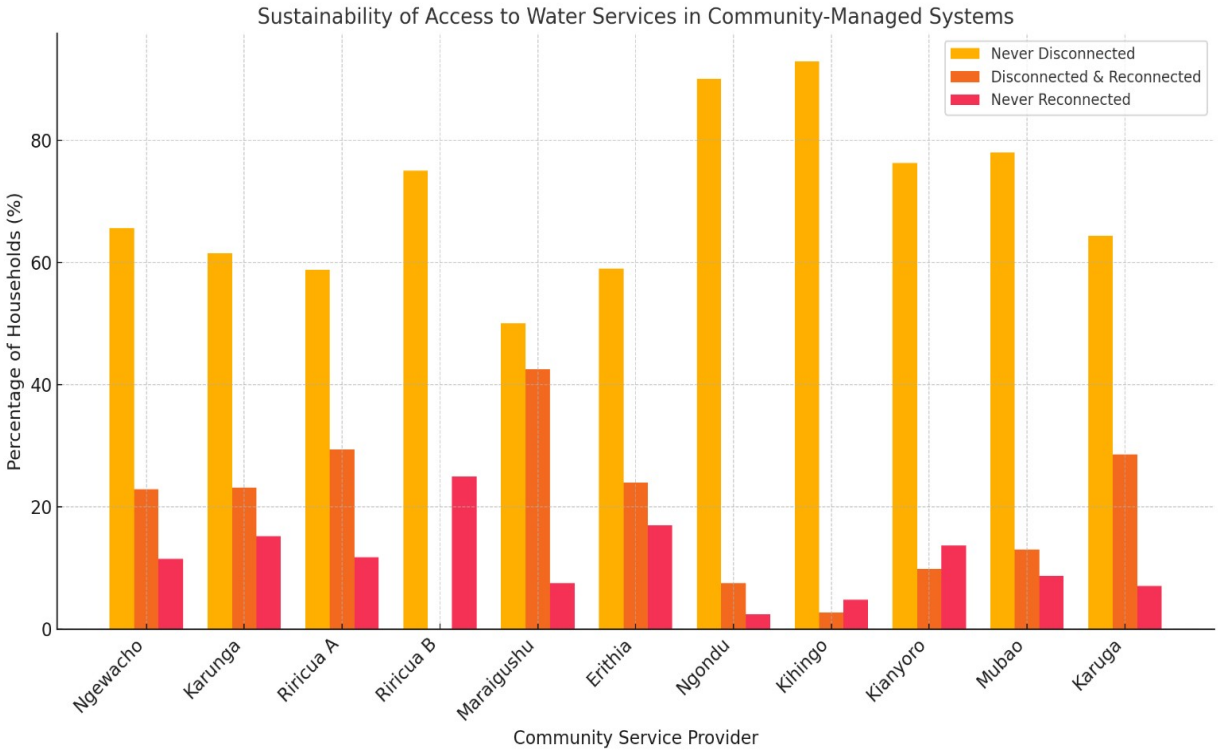


Figure 4. 1: Beneficiaries of Piped-to-households community-managed supply and sustained access. Source: field data 2020

The first and perhaps most critical indicator of sustainability is the percentage of households that never experienced water service disconnection. These households represent the most stable and consistent users of the system. Additionally, their experience reflects positively on the governance, maintenance, and affordability of water services. Among the eleven community service providers surveyed, Kihingo exhibited the highest proportion of households with uninterrupted service at 92.9%, followed closely by Ngondu at 90%, and Mubao at 78%. Similarly, Kianyoro and Riricua B had relatively high figures at 76.3% and 75%, respectively. These providers offer more dependable services. Strong operational frameworks, better infrastructure maintenance, and effective tariff collection systems underpin them. The high levels of uninterrupted access in these areas suggest that the water systems are well managed and that the community structures in place are successful in preventing disconnections, which often arise from payment defaults, infrastructural breakdowns, or seasonal supply challenges. Conversely, Maraigushu, Riricua A, and Karunga demonstrated a comparatively lower percentage of households that retained continuous water

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access, standing at 50%, 58.8%, and 61.5% respectively. These figures indicate higher vulnerability and suggest that a significant portion of households experience service interruptions. In Maraigushu, the situation appears particularly fragile, with only half of the households reporting uninterrupted service. Such a scenario might point to systemic challenges such as recurring breakdowns in the water infrastructure, poor financial sustainability, or weak enforcement of payment systems.

Another critical group comprises households that experienced disconnection but later reconnected to the service. These households, though interrupted at some point, chose to return to the system, which implies a perceived value and benefit in the community-managed water services. Maraigushu leads in this category with 42.5% of households falling into this bracket, indicating that while disconnections were frequent, the service remains desirable enough for residents to seek reconnection. Riricua follows at 29.4% and Karuga at 28.6%, suggesting significant short-term service disruptions but relatively successful reintegration. This may also reflect flexible reconnection policies, supportive community leadership, or targeted interventions aimed at assisting households in settling debts or resolving infrastructural issues. The presence of high reconnection rates in certain communities is both a weakness and a strength. On one hand, it highlights underlying vulnerabilities, perhaps due to financial insecurity, irregular incomes, or poor water infrastructure that cause households to disconnect. On the other hand, reconnecting reveals that services remain accessible and that disconnection does not necessarily imply a permanent exit from the water supply system. It might also point to community resilience and the capacity to resolve water access challenges through collective action or assistance mechanisms.

The most concerning group, in terms of sustainability, is the cohort of households that were disconnected and never reconnected. These households effectively represent a loss of service access, undermining the inclusive nature of water provision goals. The highest proportion of such households was observed in Riricua, where 25% of households remained permanently disconnected. Karunga and Erithia also exhibited significant figures in this regard, at 15.2% and 17% respectively. The persistence of this group indicates systemic exclusion and may reflect socio-economic factors: marginalization, physical displacement, or lack of capacity to pay reconnection fees. Furthermore, Kianyoro, Riricua, and Ngewacho had moderately high percentages of households that never reconnected after disconnection, ranging between 11%–14%. These households may have reverted to unsafe or informal water sources such as rivers,

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open wells, or seasonal pans, potentially compromising their health and water security. The inability or unwillingness to reconnect also suggests that, for a segment of the population, the community-managed systems became either unaffordable or untrustworthy, possibly due to inconsistent service, tariff disputes, or negative past experiences. In contrast, Ngondu and Kihingo displayed the lowest percentages of permanently disconnected households at 2.5% and 4.8% respectively. These low rates complement their strong performance in the "never disconnected" category and further support the interpretation that these systems are both accessible and effectively managed. The combination of minimal disconnections and strong reconnections implies that their water systems may serve as best-practice models within the region. Aggregating the secondary data, out of the total households across all community service providers (1868 households), 65.6% had never been disconnected, 17.9% had experienced disconnection but reconnected, and 11.7% had been disconnected and never reconnected. These figures collectively point to modest household sustained access to water from community-managed services.

The study established that household socio-economic status (SES) is a critical determinant of sustained access to water services in community-managed supply systems. Using a composite index comprising household income, education level, employment type, and asset ownership, SES significantly influenced not only physical access to water but also the quality, reliability, and continuity of that access. Quantitative analysis revealed that 58.2% of households within the low SES category had irregular income streams, low asset bases, and minimal educational attainment. These households consistently reported greater difficulty in accessing water. Specifically, 66.7% of low-SES households experienced frequent service interruptions, compared to 28.4% among high-SES households. Furthermore, only 12.9% of low-SES households had any form of water storage facility, which exposed them to acute shortages during periods of rationing or system breakdowns. Affordability emerged as a major constraint. While 87.5% of high-SES households reported no difficulty meeting monthly or per-unit water tariff obligations, 72.3% of low-SES households indicated that tariffs were unaffordable, particularly during dry seasons or when maintenance needs forced their rise. As a result, many of these households resorted to unsafe alternative sources such as shallow wells, unregulated vendors, or river water, raising both health and sustainability concerns. The binary logistic regression analysis confirmed that SES had a statistically significant association with sustained access to water ($p = 0.004$). Households with higher SES had

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greater odds of uninterrupted service, access to piped connections, and ability to participate in water governance mechanisms.

The results in Figure 4.1 demonstrate clear variation in household access to water service across different community-managed systems in Nakuru County. Specifically, the proportion of households that never experience disconnection ranged from as high as 92.9% in Kihingo to as low as 50% in Maraigushu. Similarly, the proportion of households experiencing temporary disconnects but later reconnecting varied significantly, with Maraigushu recording the highest at 42.5%, compared to much lower levels in other systems. In terms of permanent disconnection, Riricua reported the highest proportion (25%), followed by Erithia (17%) and Karunga (14,2%), thereby indicating inequalities in sustained access across systems. The data show 65.6% of households maintained continuous access, 17.9% experienced interruptions but reconnected, while only 11.7% permanently lost access. The differences demonstrate that the sustainability of water access is not uniform but depends on system-specific factors such as infrastructure reliability, government effectiveness, and affordability

Figure 4.2 presents the proportion of water services sustainability status reported by study participants.

Results show that 61.5% of respondents report having sustained access to water services, while 38.5% experience un-sustained access.

Figure 4. 2: Proportion of water services sustainability status

Source: Field data (2025)

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The study established that household socio-economic status (SES) is a critical determinant of sustained access to water services in community-managed supply systems. Using a composite index comprising household income, education level, employment type, and asset ownership, SES significantly influenced not only physical access to water but also the quality, reliability, and continuity of that access.

The study findings indicate that access to water services varies significantly across key household socioeconomic characteristics, particularly education, income source, and marital status. Households with relatively high education reported higher sustainable access (71.9%) compared to those with no formal education (14.3) %, indicating that household literacy level enhances the ability to engage with and sustain water services. In addition, household income disparities show a big difference in access. Households employed in non-governmental organizations report the highest sustained access (92.9%), while those relying on remittances reported no sustained access (0%). Farming households reveal mixed results, with nearly equal proportions reporting sustained (49.2%) and unstained (50%) access, which reflects vulnerability associated with seasonal income fluctuations. The results reveal that marital status also influences sustained access. Married households showed relatively stable access (63.3%), while widowed households experienced the highest levels of unstained access (69%), suggesting socio-economic vulnerability.

The findings show that household-level factors significantly shape access to community-managed water services, with more economically stable and socially supported households exhibiting better service sustainability outcomes. Quantitative analysis revealed that 58.2% of households within the low SES category had irregular income streams, low asset bases, and minimal educational attainment. These households consistently reported greater difficulty in accessing water. Specifically, 66.7% of low-SES households experienced frequent service interruptions, compared to 28.4% among high-SES households. Furthermore, only 12.9% of low-SES households had any form of water storage facility, which exposed them to acute shortages during periods of rationing or system breakdowns. Affordability emerged as a major constraint.

While 87.5% of high-SES households reported no difficulty meeting monthly or per-unit water tariff obligations, 72.3% of low-SES households indicated that tariffs were unaffordable, particularly during dry seasons or when maintenance needs forced their rise. As a result, many of these households resorted to unsafe alternative sources such as shallow wells, unregulated vendors, or river water, raising both health and sustainability concerns. The binary logistic regression analysis confirmed that SES had a statistically significant

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association with sustained access to water (p = 0.004). Households with higher SES had greater odds of uninterrupted service, access to piped connections, and ability to participate in water governance mechanisms.

In addition, variations observed across different community-managed systems suggest that governance practices such as tariff enforcement, accountability, and responsiveness may further explain differences in access, as systems with stronger institutional performance (e.g, Kihingo and Ngondu) recorded higher levels of sustained service.

4.3 Analyses of Household Socio-Economic Factors on Sustained Access to Service from Community-Managed Water Supply

The first objective of this study was to examine the influence of socio-economic factors associated with sustained access to community-managed water services among connected and non-connected members. The socio-economic status (SES) considered in this study included education level, source of income information, marital status, family size, and age. Table 4.1 summarizes the findings.

Table 4. 1: Summary of descriptive analysis on SES

Variable	Frequency	Percent
Education Level		
No formal schooling	7	5.4
Primary	40	30.8
Secondary	64	49.2
Greater than secondary	19	14.6
Source of Income		
Farming	65	50
Business	13	10
Employed by the government/Govt Agencies	10	7.7
Employed in non-government Agencies	14	10.8
Daily labour (casuals paid on a daily wages)	7	5.4
Self-employed	18	13.8
Remittances	3	2.3
Marital status		
Single	18	13.8
Married	79	60.8
Separated	8	6.2
Divorced	2	1.5
Widowed	23	17.7
Family Size		
Mean	4.6	
SE. Mean	0.2	
Minimum	1	
Maximum	12	
Age (Years)		

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Mean	52.1
SE. Mean	1.3
Minimum	28
Maximum	88

Source: Field Data (2025)

The results reveal that most respondents had achieved at least secondary education. Specifically, 49.2% of respondents had completed secondary education, while 30.8% had attained primary education. A smaller proportion, 14.6%, had education beyond the secondary level, and a minimal 5.4% had no formal schooling. This distribution indicates a relatively educated population, which could influence the understanding and utilization of community-managed water supply. Higher education levels are assumed to correlate with better knowledge and practices regarding water usage and conservation, which might affect sustained access to community-managed water supply. The findings of this study are consistent with Adams & Smith (2018), Koehler, Thomas & Hope (2015), and Mudege et al. (2017), who reported that a relatively educated population influences water users' engagement in the community-managed water systems.

Income sources among the surveyed households show a predominance of agricultural activities, with 50.0% of respondents relying on farming. Other notable sources of income include self-employment (13.8%) and business activities (10.0%). Employment in government (7.7%) and non-government (10.8%) agencies also contributes significantly. A smaller percentage of households depend on daily labour (5.4%) and remittances (2. 3%).

The study hypothesizes that diversity in income sources suggests varying economic stability and resource availability among households, which can influence their ability to sustain payments for community-managed water supply. Availability and affordability of water were one of the strongest pillars of livelihood coping mechanisms. Evidence from FGDs suggests that households maximize use of water as a contributing source of income by either growing vegetables for sale, and at some point, the water is helpful since its availability and affordability determine the household capacity to rear animals and later sell them at a profit.

One of the participants observed,

> "*One is able to plant onions, kales and when it is supplied, you are able to water them and have something to eat. You can also sell the kales" (FGD2)*

Another one noted that:

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> *"I can say that water is good. It really helps us in farming, giving water to cows and to plant kales and onions, things like that. The challenges come in when they disconnect the water. You see, you even lack drinking water, and also the money-making is reduced" (FGD2).*

The findings are consistent with the findings of Brooks et al. (2020), Whaley & Cleaver (2017) and Hope & Thomas (2014), whose studies confirmed that among the various livelihoods, agriculture remains the backbone for rural households.

As regards marital status, data indicate that 60.8% of respondents are married while 17.7% of respondents are widowed, which could affect household dynamics and economic status. Smaller proportions of the population are single (13.8%), separated (6.2%), or divorced (1.5%). The findings of this study, especially on the married respondents and smaller proportions of single, widowed, or divorced respondents is consistent with the findings of Brooks et al., (2020), Mudege et al., (2017), and Kohler, Thomas & Hope (2015), who revealed that, being married contributes in the household water management and engagement with community-based water systems. The average family size among surveyed households is 4.6 members, with the range extending from single-member households to those with up to 12 members. The standard error of the mean is 0.2, indicating a moderate variability in family sizes. Typically, larger households may have higher water needs, which can influence the demand and usage patterns of community-managed water supply compared to smaller households. The study hypothesizes that these variations in family structure may present unique challenges or advantages in terms of household water management. These findings are consistent with Whale & Cleaver (2017) and Thomas & Nkongo (2020), who revealed that larger households have higher water needs and therefore may face challenges in water management.

Respondents' ages ranged from 28 to 88 years, with a mean age of 52.1 years and a standard error of 1.3 years. This indicates a mature population, with a broad age distribution encompassing both younger and older adults. Respondents' ages can significantly influence their perceptions and use of community-managed water supplies. Older individuals might prioritize reliability and ease of access, while younger respondents could be more adaptable to changes and new technologies in water management. Understanding age demographics is crucial for tailoring water service policies and interventions to meet the needs of all age groups effectively (Mudege et al., 2015; Koehler et al., 2015). These findings are consistent with the findings of Brooks et al. (2020), Mudege et al. (2015), and Koehler et al. (2015),

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who revealed that age demographics matter in designing interventions for sustainable water service access.

The study found that 80 (61.5%) of users found water services sustainable, while 50 (38.5%) found water services unsustainable. The table below presents a cross-tabulation between sustainable water access to community-managed supply and different educational levels, sources of income, and marital status, alongside a chi-square test of association (p-value). The purpose of this analysis was to examine whether there is any significant association between these individual socio-economic statuses and sustained access to water service. The percentage of each sustained access to service category is distributed across each level of education, sources of income, and marital status to establish the bulk in each category.

Table 4. 2: Summary of cross-tabulation analysis for socio-economic characteristics and sustained access to water from a community-managed piped water service

Table 4.3: Summary of cross-tabulation analysis for SES

Variable	Sustainable access to service	Unsustainable access to service	P-value
Education Level			0.006
No formal schooling	1(14.3%)	6(85.7%)	
Primary	25(62.5%)	15(37.5%)	
Secondary	46(71.9%)	18(28.1%)	
Greater than secondary	8(42.1%)	11(57.9%)	
Sources of Income			0.002
Farming	32(49.2%)	33(50.8%)	
Business	9(69.2%)	4(30.8%)	
Employed by Govt	6(60%)	4(40%)	
Employed in non-govt.	13(92.9%)	1(7.1%)	
Daily Casual Labour	7(100%)	0(0%)	
Self-employed	13(72.2%)	5(27.8%)	
Remittances	0(0%)	3(100%)	
Marital status			0.005
Single	14(77.8%)	4(22.2%)	
Married	50(63.3%)	29(36.7%)	
Separated	7(87.5%)	1(12.5%)	
Divorced	2(100%)	0(0%)	
Widowed	7(30.4%)	16(69.6%)	

Source: Field Data (2025)

Results show a statistically significant association between education level and the sustainable access to service of community-managed water supply (p = 0.006). Among

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respondents with no formal schooling, a large majority (85.7%) reported unsustainable access, with only 14.3% indicating sustainable service. For those with primary education, 62.5% reported sustainable access compared to 37.5% who reported unsustainable access. A similar pattern is observed among respondents with secondary education, where 71.9% reported sustainable access and 28.1% reported unsustainable access. However, respondents with education beyond secondary school showed a reversal of this trend, with 57.9% reporting unsustainable access compared to 42.1% reporting sustainable access. These findings suggest that basic and secondary education are associated with more positive perceptions of water service sustainability, while higher education may be linked to more critical evaluation of service performance. These findings are consistent with Adams & Smit (2018), Koehler, Thomas & Hope (2015), Mudege et al. (2017), and Whaley and Cleaver (2017), whose studies concluded that education improves water knowledge and user participation, thereby influencing perceptions and management of sustainable water services.

The source of household income also demonstrates a statistically significant relationship the reported sustainable access to water services ($p = 0.002$). Households engaged in farming reported nearly equal outcomes, with 49.2% indicating sustainable access and 50.8% indicating unsustainable access, suggesting mixed experiences. Business owners showed more favorable outcomes, with 69.2% reporting sustainable access compared to 30.8% reporting unsustainable access. Among government employees, 60% reported sustainable access and 40% unsustainable access. Notably, respondents employed in non-governmental organizations reported very high levels of sustainable access (92.9%), with only 7.1% reporting unsustainable access. Daily casual laborers uniformly reported sustainable access (100%). Similarly, self-employed respondents showed strong positive outcomes, with 72.2% reporting sustainable access compared to 27.8% reporting unsustainable access. In contrast, all respondents relying on remittances reported unsustainable access (100%). This pattern may imply that more diversified or regularized income streams improve a household's ability to meet user fees, connection charges, and maintenance contributions, thereby supporting more reliable access. Heavy dependence on farming, which is often seasonal and vulnerable to climatic and market fluctuations, may undermine service continuity. The findings also suggest that more stable and diversified income sources, particularly non-governmental employment and self-employment, are associated with a higher likelihood of sustainable water service access, while reliance on remittances is linked to poorer outcomes. These findings agree with Koehler, Thomas & Hope (2015), Mudege et al. (2017), and Whaley and

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Cleaver (2017), who emphasize the role of household livelihood strategies in shaping water service sustainability.

Similarly, marital status shows a significant association with the perceived sustainable access to water services (p = 0.005). Among single respondents, 77.8% reported sustainable access compared to 22.2% who reported unsustainable access. Married respondents also showed relatively strong outcomes, with 63.3% reporting sustainable access and 36.7% reporting unsustainable access. Separated individuals reported the highest level of sustainable access (87.5%), with only 12.5% reporting unsustainable access. Divorced respondents uniformly reported sustainable access (100%), although this may reflect small sample sizes. In contrast, widowed respondents were more likely to report unsustainable access, with 69.6% indicating unsustainable service compared to only 30.4% reporting sustainable access. These results suggest that marital status, particularly being married or in a stable household structure, is associated with better access to sustainable water services, while widowed individuals may face greater vulnerability and challenges in maintaining consistent water access. These findings concur with Ndiritu et al. (2018), who reported that sustainable access to community-managed water services is closely associated with household socio-economic characteristics, particularly stability within the household structure.

While cross-tabulations provide useful information regarding the association between sustained access to water service and individual categorical independent variables, they do not adequately account for continuous variables such as age or for the combined influence of multiple predictors. Therefore, multivariate analyses that account for more than a single variable may be more desirable for examining the marginal contributions of both categorical and continuous independent predictors simultaneously while controlling for the effect of other factors. The dependent variable was coded as 1 for sustained access and 0 for unsustained access. Table 4.3 presents the logistic regression model.

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Table 4. 4: Summary of Binary logistic regression model on households' socio-economic factors

Variable	Beta	Std. Error	Wald	Odds Ratio	P value
(Intercept)	0.417	0.421	0.980	1.517	0.322
Education (Ref: Secondary)					
No formal schooling	-1.883	1.194	2.497	0.152	0.115
Primary	-0.31	0.411	0.57	0.732	0.448

	2		6		
	-0.94		2.92		
Greater than secondary	7	0.554	1	0.388	0.087
Main Source of income (Ref: Farming)					
			0.99		
Business	0.668	0.670	4	1.950	0.319
			0.18		
Employed by Govt	0.293	0.682	5	1.340	0.667
			3.01		
Employed in non-govt	1.692	0.974	7	5.430	0.082
Daily casual labour	1.413	1.099	1.65	4.108	0.198
			4		
Self-employed	0.699	0.549	1.62	2.012	0.203
			1		
Remittances	-1.56	1.640	0.90	0.210	0.342
	0		4		
Marital status (Ref: Married)					
Single	0.512	0.557	0.84	1.669	0.358
			5		
Separated	1.002	0.981	1.04	2.724	0.307
			2		
Divorced	1.223	1.489	0.67	3.397	0.412
			4		
Widowed	-1.03	0.548	3.54	0.356	0.060
	2		6		
Family size	0.099	0.211	0.22	1.104	0.639
			0		
Age	-0.67	0.225	9.05	0.508	0.003
	7		4		

Source: Field data 2025

Results show that education was not a statistically significant predictor of sustained access to service from community-managed water supply. Compared with respondents who attained secondary education, those with no formal schooling (OR = 0.152, p = 0.115), primary education (OR = 0.732, p = 0.448), and greater than secondary education (OR = 0.388, p = 0.087) showed lower odds of reporting sustained access. Although these effects were not statistically significant in the fully adjusted regression model, education was significant when considered in isolation in cross-tabulation analysis. This suggests that its influence is partly mediated by demographic factors such as age and family size. This suggests that while education enhances awareness, its independent effect diminishes when broader socio-demographic conditions are accounted for. These findings align with studies by Adams and Smith (2018), Koehler, Thomas and Hope (2015), Mudege et al. (2017), and Whaley and

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Cleaver (2017), who highlight the importance of literacy and educational attainment in sustaining community-based water services.

Using farming as the reference category, source of income was not statistically significant in the final model, although the direction of effects remained substantively meaningful. Households employed in the non-government sector had higher odds of reporting sustained access (OR = 5.432, p = 0.082), while those engaged in business (OR = 1.950, p = 0.319) and self-employment (OR = 2.012, p = 0.203) also demonstrated positive associations. These relationships were statistically significant in earlier models but weakened after controlling for age and family size. In simple terms, households with more stable or diversified incomes are more likely to maintain reliable water services than those dependent on farming. This pattern reflects the vulnerability of agricultural livelihoods to seasonal income fluctuations, which can limit households' ability to pay tariffs or participate in water governance. The findings are consistent with Adams and Smith (2018), Koehler et al. (2015), Mudege et al. (2017), and Whaley and Cleaver (2017). whose studies concluded that education improves water knowledge and user participation, thereby influencing perceptions and management of sustainable water services.

Marital status did not significantly influence sustained access in the final model. Compared with married respondents, single (OR = 1.669, p = 0.358), separated (OR = 2.724, p = 0.307), and divorced individuals (OR = 3.397, p = 0.412) showed higher but non-significant odds, while widowed respondents exhibited lower odds (OR = 0.356, p = 0.060). These findings suggest that marital status alone does not independently determine perceptions of water service sustainability. Although marital status showed modest effects in earlier models, its influence appears to be indirect, mediated through economic stability and household structure. Similar observations have been reported by Adams and Smith (2018) and Whaley and Cleaver (2017), who note that household decision-making and participation in water governance depend more on economic capacity than marital status.

Family size was not significantly associated with sustained access (OR = 1.104, p = 0.639). This indicates that larger households were neither more nor less likely to perceive water services as sustainable. While larger families may benefit from pooled labour and resources, they also face increased water demand and expenditure. The absence of statistical significance suggests that household size alone does not determine perceptions of sustainability and that economic and institutional factors play a more decisive role.

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Age emerged as the only statistically significant predictor in the final model (OR = 0.508, p = 0.003). This negative association indicates that older respondents were less likely to perceive water services as sustainable. In simple terms, younger households were more likely to report reliable and sustained access. Age was not included in earlier models; however, its inclusion explains the weakening of education and income effects, suggesting that these factors are partly confounded by generational differences. Older individuals are more likely to rely on traditional livelihoods such as farming and may have limited exposure to formal education or modern water governance systems. These findings are consistent with Adams and Smith (2018), Koehler, Thomas and Hope (2015), and Mudege et al. (2017), who equally highlight the role of demographic dynamics in shaping water service sustainability.

The findings demonstrated that sustained access to community-managed water services is shaped by a complex interplay of socio-economic and demographic factors. In accessible terms, households with higher education, stable income sources, and younger household heads are more likely to maintain reliable water service access, while those dependent on subsistence livelihoods or characterized by older demographic profiles face greater challenges. From the perspective of Capability Theory (Sen, 1999), the results demonstrate that education, income, and demographic characteristics influence households' capabilities to access and sustain essential services. Investments in human capital and livelihood diversification enhance households' freedom to secure reliable water access.

Similarly, Socio-Technical Systems Theory emphasizes that water service sustainability is not merely a technical issue but a product of interactions between infrastructure, institutions, and social conditions. The attenuation of socio-economic effects after controlling for demographic variables highlights the interconnected nature of these systems. Sustainable water management therefore requires integrated interventions that address both technical efficiency and socio-economic inequalities. These findings reinforce existing literature demonstrating that socio-economic status, participation in governance, and livelihood stability are central to the sustainability of community-managed water systems (Adams & Smith, 2018; Koehler, Thomas & Hope, 2015; Mudege et al., 2017; Whaley & Cleaver, 2017). The findings of this study demonstrate that sustained access to piped water from community-managed water supply depends not only on infrastructure alone, but also on household socioeconomic capacity, and the border governance environment plays a critical role. Although socio-economic factors (education, income source, and marital status) revealed significant associations in the cross-tabulation analysis, only age remained

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statistically significant in the full adjusted logistic regression model. This suggests that socio-economic characteristics interact in complex ways rather than operating independently.

4.4 Analyse of Influence of Access to Water Service for Livelihood on Sustained Access to Community-Managed Water Supply

The second objective was to assess the influence of household access to water for livelihood on sustained access to Community-managed water supply. The livelihood practices considered in this study include households keeping livestock, households watering animals during the dry season, households watering vegetables, and households selling water for income. Table 4.4 below summarizes the descriptive results.

Table 4.4: Descriptive statistics: Household access to water for livelihood

Variable Description	Response	Frequency	Percent
Household keeps Goats, Cows, sheep, or Pigs	Yes	86	66.2%
	No	44	33.8%
During the Dry season, households water these animals	Yes	79	91.9%
	No	7	8.1%
Household waters Vegetable or Crops	Yes	80	62.5%
	No	48	37.5%
Type of Vegetable or Crops watered	Vegetables & Potatoes	20	25.3%
	Vegetables	13	16.5%
	Onions, Vegetables & Tomatoes	12	15.2%
	Vegetables & Onion	12	15.2%
	Sukumawiki	7	8.9%
	Onions	4	5.1%
	Kales	4	5.1%
	Others	7	8.9%
During dry season household sell piped water for income	Yes	83	63.8%
	No	47	36.2%

Source: Field Data (2025)

The findings indicate that a significant proportion of households engage in small-scale livestock keeping as part of their livelihood strategies. Specifically, 66.2% of households reported keeping animals such as goats, cows, sheep, or pigs, while 33.8% did not engage in any form of livestock rearing. Among those keeping livestock, an overwhelming 91.9% indicated that they water their animals during the dry season, highlighting the critical role that

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consistent water access plays in maintaining livestock health and productivity during periods of water scarcity. The results of this study are consistent with the study findings of Mekonnen and Hoekstra (2016), who report that livestock requires substantial water inputs; therefore, making water access an essential resource helps in maintaining herd health. On the same Wasonga et al. (2021) revealed that livestock watering is key driver of household water demand especially during the dry season. Furthermore, research Ngigi et al. (2011) revealed that smallholder farmers integrate livestock into livelihood systems and that water availability is linked to livestock productivity and survival.

In addition to livestock rearing, a substantial number of households (62.5%) reported using water for irrigating vegetables or crops, demonstrating the importance of community-managed water supply in supporting subsistence and small-scale commercial farming. Conversely, 37.5% of households did not engage in crop irrigation. A closer examination of the types of crops watered reveals a diversity of produce, with the most common being a combination of vegetables and potatoes (25.3%), followed by vegetables alone (16.5%), and mixed combinations such as onions, vegetables, and tomatoes (15.2%) or vegetables and onions (15.2%). Less common were single crops like kales (8.9%), onions (5.1%), and kales (5.1%). A further 8.9% of households irrigated other unspecified crops, indicating some degree of agricultural diversification. The findings are consistent with the earlier research of Gichuki (2019) and Njenga et al. (2019), showing that when households have a dependable water supply, they can engage in crop irrigation as well as diversify their agricultural production. These studies suggest that community-managed water systems are fundamental in sustaining agricultural livelihoods, thereby enhancing household resilience and food security.

Moreover, water supply also serves as a source of income for some households. About 63.8% of respondents reported selling piped water during the dry season, suggesting that access to water infrastructure not only supports household needs but also presents a livelihood opportunity through informal water vending. However, 36.2% of households do not engage in this practice, potentially due to limited infrastructure or water availability. These results are consistent with previous study findings by Foster and Hope (2017), which documented informal water selling as a widespread livelihood practice, specifically when the water infrastructure allows commercial use, which enhances household economic resilience among rural households.

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Overall, the data illustrates that the sustained access to service from a community-managed water supply in Nakuru County is closely tied to its utility in supporting key livelihood activities, particularly livestock rearing, crop irrigation, and informal water trade, especially during dry periods. These findings underline the significance of reliable water access in promoting economic resilience and sustaining community water schemes.

Table 4. 5: Cross-tabulation - Access to water for livelihoods Vs sustained service from community-managed water supply

Variable	Sustainable access to Service	Unsustainable access to Service	P-Value
Household keeps Goats, Cows, sheep or Pigs			<.001
Yes	41(47.7%)	45(52.3%)	
No	39(88.6%)	5(11.4%)	
During the Dry season, household waters these animals			0.447
Yes	37(46.8%)	42(53.2%)	
No	4(57.1%)	3(42.9%)	
Household waters Vegetable or Crops			
Yes	58(72.5%)	22(27.5%)	<.001
No	20(41.7%)	28(58.3%)	
Type of Vegetable or Crops watered			0.055
Vegetables and potatoes	13(65%)	7(35%)	
Vegetables	8(61.5%)	5(38.5%)	
Vegetables, onion			
Onions, vegetables, tomatoes	11(91.7%)	1(8.3%)	
Kales	3(42.9%)	4(57.1%)	
Kales			
Onions	3(75%)	1(25%)	
Others	4(57.1%)	3(42.9%)	
During dry season household sell piped water for income			0.278
Yes	49(59%)	34(41%)	
No	31(66%)	16(34%)	

*Source: Field Data (*2025**)**

The cross-tabulation analysis explores the association between sustainable access to service for livelihoods and community-managed water supply in the two study locations. Overall, the findings show a mixed pattern, indicating that some livelihood-related uses of water are significantly associated with sustained access, while others are not. Specifically, statistically significant associations were observed for livestock ownership ($p < .001$) and household watering of vegetables or crops ($p < .001$), whereas watering animals during the dry season (p

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= 0.447), type of vegetables or crops watered (p = 0.055), and selling piped water for income during the dry season (p = 0.278) did not show statistically significant associations at the 5 percent level. These results suggest that access to water for livelihood is related to sustained service access, but the relationship is selective rather than universal across all livelihood practices

A highly significant relationship (p < 0.001) was found between livestock keeping and sustainable access to service. Among households with sustainable water services, 47.7% reported keeping livestock such as goats, cows, sheep, or pigs, while a higher proportion (52.3%) of those with unsustainable access reported keeping livestock. In contrast, households that did not keep livestock were far more likely to report sustainable access (88.6%) than to report unsustainable access (11.4%). This pattern suggests that livestock keeping is associated with a greater likelihood of experiencing unsustainable water service. The additional demand placed on water systems by livestock may increase pressure on already constrained supply systems, thereby contributing to service unreliability. These findings partially align with previous studies by Ngetich et al. (2021) and Tshirley et al. (2019), although the current results suggest that livestock keeping may also strain water systems where supply is limited.

Regarding the watering of animals during the dry season, the relationship with service sustainability was not statistically significant (p = 0.447). Among households that reported watering animals, 46.8% experienced sustainable access while 53.2% experienced unsustainable access. Among those who did not water animals during the dry season, 57.1% reported sustainable access compared to 42.9% reporting unsustainable access. These differences are relatively small and statistically insignificant, indicating that watering livestock during dry periods does not meaningfully distinguish between households with sustainable and unsustainable water access. This suggests that while livestock ownership may influence water demand, watering animals during dry seasons is a common necessity across households regardless of service reliability. These findings align with Chigbu (2020), Aseete et al. (2024), and Getyengana et al. 2023), who noted that livestock watering is a universal need and not a defining factor in service sustainability.

A strong and statistically significant association was observed between irrigation of crops or vegetables and sustainable access to service (p < 0.001). Among households that reported watering vegetables or crops, a substantial majority (72.5%) experienced sustainable access, compared to only 27.5% who experienced unsustainable access. In contrast, among

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households that did not engage in irrigation, only 41.7% reported sustainable access while a higher proportion (58.3%) reported unsustainable access. This indicates that households with reliable and sustained water access are more likely to engage in irrigation activities. It suggests that sustainable water systems enable households to extend water use beyond basic domestic needs to productive activities. These findings are consistent with Magumya and Nzioka (2019) and Van Koppen et al. (2020), who emphasize that reliable water access supports livelihood diversification, including small-scale irrigation.

The types of vegetables or crops watered varied across households, although the association with service sustainability was not statistically significant ($p = 0.055$). Households with sustainable access showed higher proportions in diversified cropping patterns, such as onions, vegetables, and tomatoes (91.7%), vegetables and potatoes (65%), and onions only (75%). In contrast, households with unsustainable access were more represented in less consistent or limited patterns such as kales (57.1% unsustainable) and mixed "other" categories (42.9% unsustainable). While these differences suggest that reliable water access may support crop diversification, the lack of statistical significance indicates that these patterns should be interpreted with caution. Nonetheless, the observed tendency aligns with findings by Mugumya and Nzioka (2019), who reported that reliable water access encourages diversification, whereas unreliable access constrains it.

Lastly, selling piped water for income during the dry season showed no statistically significant association with sustainable access to services ($p = 0.278$). Among households that reported selling water, 59% experienced sustainable access while 41% experienced unsustainable access. Similarly, among those who did not sell water, 66% reported sustainable access compared to 34% reporting unsustainable access. These relatively similar proportions indicate that water vending is practiced across both groups regardless of service reliability. This suggests that selling water is primarily a livelihood strategy driven by opportunity and demand rather than the stability of the water system itself. This finding is consistent with Gichuki (2019), who observed that households often engage in water vending as an income-generating activity irrespective of system performance, particularly during periods of scarcity.

In general, the analysis demonstrates that crop irrigation and livestock keeping are central to how households utilize water for livelihoods, but these activities can have complex effects on the sustainability of community-managed supply systems. Particularly, irrigation appears more compatible with sustained water service, while intensive livestock keeping results in

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overuse and pressure on the system. These findings are essential for guiding policies and interventions aimed at promoting sustainable water management in rural communities.

Table 4. 6: Binary logistic regression model on influence of water for livelihood on sustained service from community-managed water supply

Variable	Beta	Std. Error	Wald	Odds Ratio	P value
(Intercept)	-0.482	0.391	1.520	0.617	0.218
Household keeps goats, cows, sheep or pigs (Ref: No)					
Yes	0.736	0.284	6.718	2.089	0.009
Household waters vegetables or crops (Ref: No)					
Yes	-0.725	0.442	2.690	0.484	0.101
During dry season, household sells piped water for income (Ref: No)					
Yes	0.823	0.438	3.531	2.277	0.06

Source: Field Data (2025)

The study's descriptive findings demonstrate that a significant proportion of households depended on water for livelihood activities beyond domestic consumption. Specifically, households reported using piped water for livestock keeping, watering vegetables, and selling water to neighbors during dry seasons. Livestock keeping was found to be the most common livelihood activity, followed by watering vegetable production and small-scale water vending. These livelihood practices influenced household dependence on reliable water services. The results suggest that households that kept livestock were more likely to prioritize continuous water access because water shortages immediately affected health and milk production.

The results show that livestock keeping was the strongest and most consistent predictor of sustained access to water services. Households that kept goats, cows, sheep, or pigs had about two times higher odds of reporting sustained access than households that did not keep livestock (OR = 2.089, p = 0.009). In simple terms, households that depend on water for animals were more likely to maintain reliable water service access. This effect was also significant in the earlier models, indicating that it is stable rather than accidental.

A plausible explanation is that livestock-owning households have stronger incentives to ensure water availability because water directly affects animal survival, milk production,

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market value, and household income. Such households may therefore be more willing to pay user fees, participate in maintenance, monitor breakdowns, or pressure management committees to keep systems functional. This interpretation is consistent with Ngetich et al. (2021), who noted that livestock ownership often increases household engagement with rural water systems. From a Capability Theory perspective, livestock functions as an economic asset that expands household choices and resilience. Water access is not only for consumption but also for protecting productive assets. From a Socio-Technical Systems Theory perspective, households with higher productive dependence on water may become more active users within the institutional system, thereby indirectly supporting technical sustainability.

Households that used water for watering vegetables or crops showed lower odds of reporting sustained access (OR = 0.484, p = 0.101), although this relationship was not statistically significant. In practical terms, irrigating households were somewhat less likely to report reliable service, but the evidence is not strong enough to conclude that irrigation independently reduces sustainability. This finding may appear different because the cross-tabulation suggested that irrigation households often had better access. However, once other livelihood practices are considered simultaneously, especially livestock keeping and water vending, the independent effect of irrigation weakens. This suggests that irrigation may be more of a result of good water access rather than a direct cause of sustainability. In other words, households irrigate because water is available, but irrigation alone does not necessarily sustain the system. Another plausible explanation is that crop watering can increase water demand, particularly in dry seasons, and may create competition between domestic and productive uses where supply is limited. This aligns with Mugumya and Nzioka (2019) and Van Koppen et al. (2020), who argue that productive water use can improve livelihoods but may also intensify pressure on small-scale systems when governance is weak.

Selling piped water for income during the dry season showed a positive and marginally significant association with sustained access (OR = 2.277, p = 0.060). This means that households engaged in water vending were more than twice as likely to report sustainable service access, although the evidence falls just short of conventional significance thresholds. We could also argue that households that earn income from selling water are more likely to be connected to functioning and reliable systems. This is logical because informal water vending depends on having regular supply, storage capacity, or advantageous access points. These households may also have stronger financial motivation to support repairs, maintain

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relations with water committees, or invest in access infrastructure. This finding supports Foster and Hope (2017) and Wasonga et al. (2021), who observed that households using water as an economic resource often adopt more proactive strategies to preserve long-term access.

These findings show that how households use water matters for whether they experience sustainable service. Water is not merely a domestic necessity. It is also tied to livestock production, irrigation, and income generation. Households with stronger productive dependence on water appear more motivated or better positioned to maintain reliable access. Possible policy implications may include:

i) community-managed water systems should be designed with recognition that users have multiple water needs, not only drinking and cooking. Ignoring livelihood uses can lead to under-designed systems and hidden pressures on infrastructure. ii) productive users such as livestock keepers and small-scale vendors may be important partners in sustainability because they have strong incentives to keep systems functioning. Their participation in governance structures could strengthen maintenance and cost recovery. iii) productive water use must be managed carefully to avoid elite capture or overuse. Systems that favour commercial users while neglecting vulnerable households may deepen inequality. This is where Socio-Technical Systems Theory is especially useful: technical reliability depends not only on pumps and pipes, but also on fair rules, inclusive governance, and demand management. And iv) from a Capability Theory perspective, water access should be seen as enabling livelihoods, food security, and resilience. Policies that separate domestic water from economic wellbeing may underestimate the true developmental value of rural water systems.

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4.5 Influence of Convenience of Service on Households' Sustained Access to Community-Managed Water Supply

The third objective was to analyse the influence of household convenience of service on sustained access to water from community-managed supply. Table 4.7 presents a descriptive analysis of the conveniences of water services-related factors influencing the sustained access to service of community-managed water supply. The table includes data on the distance to the water source, service availability, and the cost of the service, highlighting their potential impact on user engagement and sustained access to service.

Table 4. 7: Summary of descriptive analysis on convenience of water services

Variable	Frequency	Percent
Distance to Source		
Far Away	60	46.2 %
Nearer	70	53.8 %
Service Availability		
Always Available	61	46.9 %
Rarely Available	69	53.1 %
Cost of Service		
High	62	47.7 %
Low	68	52.3 %

Source: Field Data (2025)

The results show that a slight majority of households (53.8%) are located nearer to the water source, while 46.2% are farther away from it. Convenient water services to the water source are crucial, as households closer to the source are likely to find it more convenient to use and maintain regular access to water services. These conveniences can lead to higher sustained access to services compared to those living farther away, who may face more challenges in accessing the water source. Evidence from FGDs suggests that access to clean and reliable water is a major challenge. Many women described the pain and struggle of walking long distances to fetch water, especially after disconnection. For many, water was supplied only once a week, and this was often not enough to meet daily household needs. The burden was compounded when households had young children or livestock. When asked about the effect of water disconnection, women repeatedly highlighted how the lack of access disrupted hygiene, cooking and caregiving routines. One participant shared:

> *"When the water was disconnected, I had just given birth to twins. I had many clothes to wash, and walking long distances with back pain was unbearable. I had to pay people to fetch water for me, and my children wore dirty clothes. It even led to quarrels at home."* (FGD1)

Another added:

> *"We were forced to fetch water from the river, which is very far. Sometimes, I had to wait until I got money to pay a motorbike to bring water. There were days I even slept hungry because there was no water to cook with."* (FGD1)

Women also noted that even after reconnection, low water pressure and short supply durations remained issues:

> *"The water only comes once a week, and when I'm not home, I miss it. Sometimes the pressure is so low that it doesn't even reach where we store it."* (FGD3)

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This is consistent with the findings of studies by Mudega et al. (2017) and Whaley (2017), which show that households that participate in community-managed water systems report better service reliability and are more inclined to continue using them. Longer distances frequently result in lower utilization, increase collection effort, and negatively affect views of service sustainability. The availability of the water service is nearly split, with 46.9% of households reporting that the service is always available and 53.1% stating it is rarely available. Consistent availability of water services is a significant factor in sustained access to service. Households with reliable water service are more likely to continue using the service, while those experiencing sporadic availability may seek alternative sources. This reduces their reliance on the community-managed service. These findings are consistent with previous studies' findings of Adams et al. (2019) and Foster et al. (2018), confirming that irregular water availability undermines household confidence, which leads to reduced usage and wreaks system sustainability.

There is even distribution of the cost of the service, with 52.3% of households considering it low and 47.7% finding it high. Affordability plays a critical role in the sustained access to water services. Lower costs make the service more accessible to a broader range of households, promoting regular and continued use. Conversely, higher costs may deter some households from using the service consistently, affecting overall sustained access to service. This aligns with findings from Carte et al. (2019), who reported that users always pay more for water if the services are reliable and well managed.

The cross-tabulation analysis in Table 4.8 examines the influence of distance to the water source, service availability, and cost of service on the sustained access to service of community-managed water supply. manger.

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Table 4. 8: Cross tabulation analysis of household conveniences of water services

Variable	Unsustainable access to service	Sustainable access to service	P-value
Distance to Source			0.290
Far Away	26(43.3%)	34(56.7%)	
Nearer	24(34.3%)	46(65.7%)	
Service Availability			0.001
Always Available	8(13.1%)	53(86.9%)	
Rarely Available	42(60.9%)	27(39.1%)	
Cost of Service			0.304
High	21(33.9%)	41(66.1%)	
Low	29(42.6%)	39(57.4%)	

*Source: Field Data (*2025**)**

Table 4.8 presents the cross-tabulation analysis examining whether dimensions of service convenience are associated with sustained access to piped water from a community-managed water supply. The results reveal that the relationship between convenience and sustained access is differentiated across the indicators considered. Of the three convenience-related variables examined, only service availability shows a statistically significant association with sustained access ($p = 0.001$), while distance to source ($p = 0.290$) and cost of service ($p = 0.304$) do not demonstrate statistically significant relationships at the 5% level. Thus, the findings suggest that convenience of water service is associated with sustained access, but this association is driven principally by reliability of service rather than physical proximity or perceived cost alone.

By contrast, distance to the water source does not show a statistically significant association with sustained access. Households nearer to the water source show a higher proportion of sustainable access to service (65.7%) compared to those located farther away (56.7%). Conversely, households located far away report a higher proportion of unsustainable access (43.3%) compared to those nearer (34.3%). However, the p-value (0.290) indicates that this difference is not statistically significant. This suggests that although proximity to the water source may offer practical advantages in ease of access and reduced effort in water collection, it does not independently determine whether access is sustained over time. The convenience associated with shorter distances may improve access frequency but may not necessarily translate into long-term service reliability. These findings are consistent with previous research by Geere & Hunter (2020), which highlights that shorter distances improve access and usage, although not always sustainability of supply.

Service availability has a strong and statistically significant association with sustainable access to water service ($p = 0.001$). Among households reporting that water is always available, a large majority (86.9%) experienced sustainable access, while only 13.1% reported unsustainable access. In contrast, among households where water is rarely available, only 39.1% reported sustainable access, while a majority (60.9%) experienced unsustainable access. This clearly demonstrates that consistent and reliable water availability is a critical determinant of sustainable service access. The findings reinforce the central role of supply reliability in shaping user experience and long-term system functionality. These results are consistent with findings from Wash-Households-Launch-Version (2023–2024), which

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emphasize that reliability of water supply is fundamental to sustaining user engagement and satisfaction.

Households perceiving the cost of service as high reported a slightly higher proportion of sustainable access (66.1%) compared to those perceiving the cost as low (57.4%). Similarly, households perceiving lower costs showed a somewhat higher proportion of unsustainable access (42.6%) compared to those perceiving higher costs (33.9%). However, this difference is not statistically significant (p = 0.304). This suggests that cost alone may not be a decisive factor in determining sustainable access to water services. Instead, households may be willing to tolerate higher costs if the service is reliable and consistently available. Therefore, the role of cost appears secondary to service availability and reliability in influencing sustainable access to water services. Research by Jennifer Davis et al. (2023) and Steven G. Wright et al. (2014) agrees with the findings of the current study, which indicate that while affordability is important, service reliability and quality often have a more pronounced effect on sustainable access to water services

Table 4. 9: Summary of binary logistic regression analysis on community-managed water supply convenience

Variable	**Beta**	**Std. Error**	**Wald**	**Odds Ratio**	**P value**
(Intercept)	-0.594	0.362	2.693	0.552	0.101
Distance to Source (Ref: Far away)					
Nearer	0.336	0.297	1.279	1.40	0.258
Service Availability (Ref: Rarely available)					
Always available	2.303	0.455	25.614	10.00	<0.001
Cost of Service (Ref: Low)					
High	0.199	0.509	0.153	1.22	0.696

*Source: Field Data (*2025**)**

The strongest predictor of sustained access was service availability. Households reporting that water was always available had ten times higher odds of reporting sustained access compared with households where water was rarely available (OR = 10.000, p < 0.001). In practical terms, households are far more likely to maintain and trust a water system when water is consistently present. This is also visible in the cross-tabulation results: 86.9% of households reporting always available water also reported sustained access, compared with only 39.1% among households where water was rarely available. This finding suggests that reliability matters more than almost any other convenience factor. Users may tolerate

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moderate costs or longer walking distances if water is dependable, but they are less likely to view a system as sustainable when supply is irregular. This supports Giné-Garriga et al. (2021), who identified reliability as a central determinant of long-term water service use and user satisfaction. From a Socio-Technical Systems Theory perspective, reliable service reflects successful interaction between infrastructure, management systems, finances, and community trust. Sustained access is therefore not only about pipes or pumps, but about institutions that keep systems functioning consistently.

Distance to the source showed a positive but non-significant relationship with sustained access. Households living nearer the source had 1.4 times higher odds of reporting sustained access than households living farther away (OR = 1.400, p = 0.258). In simple terms, households closer to water points appeared somewhat better placed, but distance alone did not strongly determine sustainability. The cross-tabulation helps explain this. Among households located nearer the source, 65.7% reported sustained access, compared with 56.7% among those farther away. While this suggests some practical advantage, the difference was almost minimal. This implies that proximity may improve convenience and reduce collection burden, but if the system itself is unreliable, being near the source offers limited benefit. This finding is consistent with Geere and Hunter (2020), who note that shorter distances reduce time and physical effort in water collection, especially in rural settings, but do not automatically guarantee sustained service quality.

It's worth noting that distance often has a gendered dimension. In many rural settings, women and girls bear the main responsibility for collecting household water. Even when distance does not predict sustainability statistically, longer walking distances may still impose hidden burdens through lost time, physical strain, and reduced opportunity for education or income generation. Women may also require water for domestic tasks, kitchen gardens, and small livestock care, meaning distance can affect livelihoods differently across gender roles. Thus, distance may not predict system sustainability directly, but it remains socially significant.

Perceived cost of service was also not statistically significant in the final model. Households perceiving costs as high had slightly higher odds of reporting sustained access than those perceiving costs as low (OR = 1.220, p = 0.696). In simple terms, households paying more were not necessarily worse off in terms of access. In fact, some may associate higher costs with better service quality or more reliable supply. The cross-tabulation supports this interpretation. 66.1% of households perceiving costs as high reported sustained access,

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compared with 57.4% among those perceiving costs as low. This suggests that households may be willing to pay more when they receive dependable service. This finding aligns with Komives et al. (2005), who argue that affordability matters, but users often prioritize reliability, safety, and convenience over low price alone. Where systems function well, higher tariffs may be accepted if they are transparent and linked to maintenance outcomes. However, this should not obscure equity concerns. Poor households may still struggle to afford even reliable services, particularly female-headed households or households with unstable incomes. Cost may therefore matter more for vulnerable sub-groups than for the sample overall.

Convenient and reliable water services also shape household livelihoods. Earlier results showed that many households use water for productive purposes such as livestock rearing, crop irrigation, and water vending. Where water is consistently available, households are better able to water animals during dry seasons, irrigate vegetables, and engage in small-scale income activities. Conversely, unreliable supply can disrupt these livelihood strategies. For example, a household may keep livestock but fail to sustain herd productivity if water is rarely available. Similarly, women managing household gardens may lose both food and income when supply interruptions occur. Thus, convenience factors do not only influence domestic access; they also affect household resilience and livelihood security. From a Capability Theory perspective (Sen, 1999), reliable and accessible water expands what households are able to do and be: produce food, generate income, maintain health, and reduce time poverty. Water convenience therefore contributes directly to human capability and well-being.

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4.6 Evaluation of Quality Water Service on Sustained Access to Community-Managed Water Services

The fourth objective was to evaluate the influence of quality of service on sustained access to water from community-managed supply. Table 4.10 provides a descriptive analysis of household perceptions regarding community-managed water supply. It examines key variables such as the quality of water service, affordability for domestic use, reliability of piped water, and overall quality of service, offering insights into the factors influencing sustained water service use. In this study, quality of service is customer service encompassing customer support, timely maintenance, and responsiveness, and not water service quality.

Table 4. 10: Summary of descriptive analysis: Quality of Community-managed Water Supply on Sustained access to Service

Variable	Frequency	Percent
Quality of Water		
High	47	36.2%
Low	83	63.8%
Affordability for Domestic Use		
Affordable	61	46.9%
Not affordable	69	53.1%
Reliability of Piped Water		
More Reliable	41	31.5%
Less Reliable	89	68.5%
Quality of Service		
High	53	40.8%
Low	77	59.2%

Source: Field Data (2025)

A significant majority of households (63.8%) perceive the quality of water provided by community-managed services as low, while only 36.2% rate the water quality as high. This finding highlights a substantial dissatisfaction with water quality among the households surveyed. More than half of the households (53.1%) consider the water not affordable for domestic use, while 46.9% find it affordable. This split may indicate that affordability is a significant concern for a considerable portion of the community and may affect sustained access to service. This aligns with findings by Mark et al. (2014), who reported that poor water quality remains a fundamental challenge, which affects user confidence in rural water systems. Similarly, Foster and Hope (2017) revealed that perception of safety may reduce reliance on the system and result in the use of unimproved sources irrespective of improved sources availability.

A notable 68.5% of households perceive piped water as less reliable, with only 31.5% finding it more reliable. This perception of unreliability suggests that interruptions and inconsistencies in water supply are common, which can undermine confidence in the service and affect its sustained access. During FGDs, several women mentioned that water interruptions resulted from damaged pipes due to construction, animals, or conflict (such as the clashes in Njoro). Some had to fund repairs themselves.

> *"A tractor stepped on my pipe during road construction. I had to buy new pipes and pay a plumber; no help from the committee."* (FGD4)

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"During clashes in Njoro, the main pipes were destroyed, and we stayed without water. That time, the committee stepped in to help." (FGD4)

This finding agrees with previous studies such as Nyangena (2020) and Wasonga et al. (2012), who linked unreliable supply to weak governance structures as well as insufficient technical capacity. Most households (59.2%) rate the quality of service provided by community-managed water systems as low, while 40.8% perceive it as high. This indicates room for significant improvements in service delivery. These mixed perceptions mirror findings from previous studies by Thomas et al. (2012) and Koehler et al. (2020), who revealed that community- managed water systems in Kenya struggle with inconsistent pressures and limited customer support.

Table 4. 11: Summary of cross-tabulation: quality of community-managed water supply

Variable	Sustainable access to service	Unsustainable access to service	P-value
Quality of Water			**0.003**
High	**21(44.7%)**	**26(55.3%)**	
Low	**59(71.1%)**	**24(28.9%)**	
Affordability for Domestic Use			0.049
Affordable	43(70.5%)	18(29.5%)	
Not affordable	37(53.6%)	32(46.4%)	
Reliability of Piped Water			0.283
More reliable	28(68.3%)	13(31.7%)	
Less reliable	52(58.4%)	37(41.6%)	
Quality of Service			0.019
High	39(73.6%)	14(26.4%)	
Low	41(53.2%)	36(46.8%)	

Source: Field Data (2025)

Table 4.11 presents the cross-tabulation results examining whether dimensions of water service quality are associated with sustained access to piped water from a community-managed water supply. Households that perceived water quality as high were more likely to report unsustainable access (55.3%) compared to sustainable access (44.7%). In contrast, households that perceived water quality as low were more likely to report sustainable access (71.1%) compared to unsustainable access (28.9%). This counterintuitive pattern suggests that perceptions of water quality do not necessarily align with service continuity. It may indicate that households experiencing more frequent service interruptions are more attentive to quality when water is available, or that households with sustained access develop tolerance to lower-quality conditions. These findings highlight the complexity of perception-based

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measures and suggest that water quality alone does not determine sustainable access. Previous research supports the importance of perceived quality in shaping user satisfaction and trust. Vorstius (2023) found that perceived water quality significantly influences consumer satisfaction and continued reliance on water services.

Affordability shows a statistically significant association with sustainable access to service (p = 0.049). Among households that perceived water as affordable, a large majority (70.5%) reported sustainable access compared to 29.5% who reported unsustainable access. In contrast, among those who perceived water as not affordable, only 53.6% reported sustainable access while a substantial proportion (46.4%) reported unsustainable access. This indicates that affordability plays an important role in sustaining water service use, although the difference is moderate. Evidence from FGDs further supports this finding, showing that financial barriers such as connection fees, pipe installation, and reconnection costs significantly affect households' ability to maintain access. For instance, one participant noted,

> *"I sold my chicken and took a loan from my women's group to pay the Kshs 10,000 and buy pipes. That's how we got water at home"* (FGD2).

Another added,

> *"When I couldn't afford the reconnection fee, I took a loan from the place where I deliver my milk. I had to plead and sacrifice a lot just to get water reconnected"* (FGD1).

These findings are consistent with Aikowe and Mazancová (2021), who emphasize that affordability is a key determinant of sustained water service access.

Although the relationship between reliability of piped water and sustainable access to service is not statistically significant (p = 0.283), the distribution suggests a meaningful trend. Households perceiving water as more reliable reported higher sustainable access (68.3%) compared to 31.7% reporting unsustainable access. Similarly, among those perceiving water as less reliable, 58.4% still reported sustainable access while 41.6% reported unsustainable access. While reliability appears to be positively associated with sustainable access, the lack of statistical significance suggests that other factors may also play important roles. These findings are broadly consistent with Giné-Garriga et al. (2021) and Denantes and Donoso (2021), who identified reliability as a key factor influencing user satisfaction, even though their study did not formally test statistical associations.

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The quality of service is also significantly associated with sustainable access to service (p = 0.019). Among households perceiving high service quality, a strong majority (73.6%) reported sustainable access compared to 26.4% reporting unsustainable access. In contrast, among those perceiving low service quality, only 53.2% reported sustainable access while 46.8% reported unsustainable access. This indicates that overall service quality, which may include aspects such as maintenance, responsiveness, and system performance, plays a critical role in sustaining water service use. These findings are consistent with Koehler (2018), who found that service quality significantly influences user satisfaction and long-term sustainability of community-managed water systems.

The binary logistic regression analysis in Table 4.12 explores how various household water quality perceptions influence the sustainable access to service of community-managed water supply across four models. Each model adds variables incrementally to understand their combined effects on sustainable access to service.

Table 4. 12: Summary of binary logistic regression analysis on quality of service by community-managed water supply.

Variable	Beta	Std. Error	Wald	Odds Ratio	P value
(Intercept)	-0.283	0.34	0.690	0.754	0.406
Quality of Water: Ref: Low					
High	1.028	0.394	6.818	2.793	0.009
Affordability for Domestic Use: Ref: Not affordable					
Affordable	0.627	0.394	2.531	1.871	0.112
Reliability of Piped Water: Ref: Less Reliable					
More Reliable	0.195	0.425	0.212	1.216	0.646
Quality of Service: Ref: Low					
High	0.652	0.408	2.554	1.919	0.110

Source: Field Data (2025)

The findings indicate that perceived water quality was the strongest and statistically significant predictor of sustained access to service in the final model. Households that perceived the quality of water as high were approximately 2.79 times more likely to sustain access to community-managed water services compared to households perceiving the water quality as low (OR = 2.79, $p < 0.05$). The persistence of this relationship after controlling for affordability, reliability, and service quality suggests that water quality plays a central role in shaping household trust and continued reliance on community-managed supply systems.

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Households appear more willing to maintain long-term use of a water service when the supplied water is perceived as safe, clean, and suitable for domestic purposes. Poor perceptions of water quality may discourage continued usage even when the infrastructure itself remains operational. Recent research supports this finding, emphasizing that good governance practices are crucial for sustainable access to community-managed water services (El-Nashar & Elyamany, 2023). The consistent significance of water quality across the model therefore underscores its critical role in influencing user satisfaction and continued engagement with community-managed water systems.

Affordability for domestic use showed a positive relationship with sustained access to service, although the effect did not attain statistical significance in the final model. Households perceiving the water service as affordable were about 1.87 times more likely to sustain access compared to households perceiving the service as unaffordable (OR = 1.87, $p > 0.05$). Although the statistical significance weakened after adjusting for other service dimensions, the positive association suggests that affordability still contributes to sustained utilization of piped water services.

Affordable tariffs may reduce the financial burden associated with household water consumption and improve willingness to remain connected to community-managed systems. However, the findings also imply that affordability alone may not guarantee sustained access unless accompanied by satisfactory service experiences and acceptable water quality. These findings are consistent with Aikowe and Mazancova (2021). These research findings are consistent with Aikowe and Mazancova (2021), who, in their study, argued that affordability has to interact with institutional trust and that users are willing to continue paying for services if they perceive there is transparency, predictability in water governance structures, and accountability in community water management. Their study further observed that users are more likely to continue paying for services when they trust the institutions managing the water supply. They further concluded that cost alone does not influence household decisions, but affordability becomes meaningful when the governance structures are predictable. In addition, previous research supports this finding, emphasizing that good governance practices are crucial for sustained access to service of community-managed supply (El-Nashar & Elyamany, 2023). The consistent significance of high-water quality across all models underscores its critical role in user satisfaction and continued access for domestic use.

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Reliability of piped water demonstrated a positive but statistically non-significant association with sustained access to service (OR = 1.22, p > 0.05). Households perceiving the water supply as more reliable were somewhat more likely to sustain access than households reporting a less reliable supply. Nevertheless, the weak statistical relationship suggests that reliability may not independently determine sustained access once other service-related factors are considered simultaneously. This finding may reflect the adaptive coping strategies frequently adopted by households in rural and peri-urban contexts, such as water storage, rationing, and supplementary sources during temporary interruptions. As a result, households may tolerate moderate levels of unreliability provided that the water remains affordable and of acceptable quality. These results agree with previous findings by Koehler et al. (2015), who reported that household coping mechanisms may reduce the direct influence of supply reliability on long-term utilization of water services.

Perceived service quality also showed a positive but not statistically significant relationship with sustained access to service (OR = 1.92, p > 0.05). Households perceiving higher service quality were nearly twice as likely to sustain access compared to those reporting low service quality. Although the relationship did not attain statistical significance, the positive direction of the effect suggests that aspects such as responsiveness to breakdowns, customer care, maintenance efficiency, communication practices, and accountability structures may still contribute to household satisfaction and continued use of community-managed water services. Service quality often shapes users' broader perceptions regarding trustworthiness and effectiveness of community water management systems. Recent research is consistent with this study by Yum & Yoo (2023), which indicates that positive service experiences strengthen customer loyalty and satisfaction, both of which are important for sustainable access to water services.

The findings of the study are supported by the three theoretical frameworks, namely the capability theory, socio-technical system theory, and common-pool resource theory, which collectively explain the factors influencing sustained access to community-managed water services. According to the capability theory, households with relatively higher education and a stable income source are not only able to understand the importance of sustaining safe water from a piped community-managed water supply but also are able to pay the water tariffs on time. The OCI-technical framework supports the findings that sustainability depends not only on physical infrastructure such as pumps, but also on service availability, reliability, customer support, maintenance, and institutional responsiveness. This is reflected

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in the strong influence of service availability (OR=10.000, $p < 0.001$) and perceived water quality (OR=2.79, $p < 0.009$) on sustained access. Common pool resource theory explains the importance of governance practices such as trust, accountability, tariff fairness, and participation in decision-making

4.7 Assessment of Governance Practices in Moderating Household Sustained Service Access to Community-Managed Water Supply

In addition to the above regression models, the influence of the moderating variable, which is on the governance characteristics of the water supply model, trust in participatory decision making, and confidence in water governance, was analyzed for each of the above 4 independent variables. The analysis facilitated an understanding of how governance factors influence sustained access to service within each water service model. On examining how the communities perceive the transparency and accountability of the water committees, and how these perceptions influence the continued use of water services. Perception of transparency within the water management committees significantly shapes the water users' trust and acceptance of community management of water services. Transparency was reflected in how openly committees communicated information regarding water tariffs, revenue collection, expenditure, and decision-making processes. In situations where households perceived that such information was openly shared and clearly explained, there was increased confidence in the management of the water system and a stronger sense of ownership among users, which supported continued use of the services.

Accountability was found to be a critical qualitative governance factor influencing sustained water use. Community members associated accountability with the committees' ability to respond to complaints, justify financial decisions, and allow community oversight of resources. where committees were perceived to be accountable, users demonstrated higher willingness to pay for water services, cooperate in maintenance activities, and maintain use of the supplied water. Conversely, where perception of transparency and accountability were weak, users expressed reduced trust in the management structures, dissatisfaction with service delivery, and, in some cases, a tendency to seek alternative water sources when available. This demonstrates that qualitative perceptions of governance play a critical role in determining the sustainability and continued use of community-managed water services.

Table 4. 13: Moderating Effect on Household Socio-Economic Factors and Sustained Access

Variable	**(Governance Moderation)**

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Education Level	
Secondary (Ref: Other)	1.58 (0.79)
Source of Income	
Farming (Ref: Other)	0.60 (0.28)
Marital Status	
Married (*Ref: Other*)	1.14 (0.54)
Family Size	1.07 (0.25)
Age	0.47** (0.13)
Governance (*Main Effects*)	
Trust in Participatory Decision-Making	1.96** (0.64)
Confidence in Water Governance	2.21** (0.69)
Interaction Terms	
Education × Trust	1.51* (0.63)
Education × Confidence	1.44* (0.61)
Income × Trust	1.39* (0.59)
Income × Confidence	1.67* (0.71)

*Note: + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$: Source: Field Data (2025)*

The analysis presented in Table 4.13 extends the earlier regression models by incorporating governance variables and their interaction with household socio-economic characteristics. After introducing trust in participatory decision-making and confidence in water governance as moderating variables, the main effects of education level and source of income remain positive but are diminished relative to Model 3. Both governance variables display strong and statistically significant positive effects on sustained access ($p < 0.01$). The interaction terms between education and governance variables are statistically significant ($p < 0.01$).

These results indicate that a household's socio-economic advantages alone are not sufficient to guarantee sustained access to community-managed water services. Instead, the effectiveness of education and income in supporting sustained use depends on the quality of governance arrangements. Households with higher education levels are significantly more likely to sustain access when they perceive water governance processes as participatory and transparent. Similarly, income-generating households demonstrate higher sustained access when they have confidence in the institutions managing water services. In contexts where governance is perceived as weak or opaque, even households with strong and stable economic capacity are deterred from using the system. From the FGD,

One of the participants expressed dissatisfaction, stating:

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" I contribute money for repairs, but no one explains how it is used, and because of that, the majority of us stop paying the water charges since we feel there is no accountability." (FGD4)

These results reveal how poor governance weakens the positive influence of both education and income on sustained access by eroding trust in institutional legitimacy The study findings are consistent with the findings of Hope et al., (2020) & Nagel et al., (2022) who revealed an interaction effect between education and governance quality, thereby confirming that governance conditions how socio-economic characteristics translate into sustained water services access.

The moderation effects suggest that governance acts as an enabling mechanism that allows the conversion of socio-economic resources into sustained service use. In poorly governed contexts, even relatively well-resourced households exhibit weaker commitment to continued participation, while in well-governed systems, socio-economic differences translate more effectively into long-term engagement. These findings align with capability theory, which emphasizes that resources require favorable conversion factors to yield meaningful outcomes.

In this study, governance quality functions as a social conversion factor that enables households to translate education and income into sustained water access. Without trust and institutional confidence, household capabilities remain constrained, regardless of resource endowment. The results demonstrate that social organization and institutional trust are critical to system sustainability. Technical access and household capacity are insufficient when governance structures fail to foster legitimacy and accountability.

Table 4. 14: Moderating effect on the influence of water for livelihood on sustained access

Variable	**(Governance Moderation)**
Livestock Keeping	1.79*** (0.60)
Vegetable / Crop Watering	−0.58 (0.46)
Selling Water in Dry Season	0.94* (0.47)
Governance (*Main Effects*)	
Trust in Participatory Decision-Making	2.38*** (0.70)
Confidence in Water Governance	2.71*** (0.76)
Interaction Terms	
Livestock × Trust	1.81* (0.72)
Livestock × Confidence	1.64* (0.69)
Livelihood Use × Trust	1.56* (0.67)
Livelihood Use × Confidence	1.73* (0.74)

*Note: + p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001:*

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Source: Field Data (2025)

Analysis presented in Table 4.14 shows that livelihood-related uses of water such as livestock keeping and seasonal water sales remain significant predictors of sustained access after accounting for governance effects. Livestock keeping continues to show a strong positive association with sustained access, while vegetable and crop watering remains statistically non-significant. Selling piped water during the dry season shows a modest but statistically significant positive effect. Both governance variables show strong main effects, with trust in participatory decision-making and confidence in water governance substantially increasing the likelihood of sustained access. The interaction terms between livelihood-related variables and governance are statistically significant, confirming that governance moderates the relationship between livelihood use and sustained service access.

The results suggest that livelihood dependence on water increases households' incentives to maintain access; however, this relationship is significantly strengthened in contexts characterized by strong governance. Households that rely on water for livestock or income generation are more likely to remain connected when they trust decision-making processes and perceive water institutions as credible. On the other hand, where governance confidence is low, livelihood dependence may not consistently translate into sustained access. Governance therefore determines whether livelihood reliance becomes a stabilizing force or a source of tension and disengagement. Evidence from FGDs suggests that households maximize use of water as a contributing source of income by either growing vegetables for sale, and at some point, the water is helpful since its availability and affordability determine the household capacity to rear animals and later sell them at a profit. Similarly, households with stable income sources indicate that their willingness to continue paying for water services depends on institutional trust and perceived accountability. From the FGD,

One of the respondents explained:

> *"Even when I have money, I will continue paying if I see that the committee is honest and repairs are done on time. If there is no transparency, I will definitely stop contributing even when I can afford it" (FGD2).*

This argument demonstrates the governance conditions and the effect of income on sustained access, therefore confirming that financial capacity does not guarantee continued service use.

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These findings reinforce the importance of governance in sustaining community-managed water services. From a capability perspective, water access supports productive capabilities such as income generation and food security. Governance failure undermines these capabilities by increasing uncertainty and perceived risk. These study findings are consistent with the study findings of Hope et al. (2020), who observed that when governance institutions are credible and can be trusted, then the livelihood reliance translates into sustained water service access.

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Table 4. 15: Moderating effect on convenience of water service and sustained

Variable	(Governance Moderation)
Nearer Distance	1.29 (0.31)
Always Available	8.63*** (4.71)
High Cost	1.16 (0.53)
Governance (*Main Effects*)	
Trust in Participatory Decision-Making	2.27** (0.69)
Confidence in Water Governance	2.48*** (0.72)
Interaction Terms	
Distance × Trust	1.43* (0.66)
Distance × Confidence	1.61* (0.70)
Availability × Trust	1.89* (0.77)
Availability × Confidence	2.02** (0.81)

*Note: + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$: Source: Field Data (2025)*

Analysis presented in Table 4.15 suggests that service availability remains the strongest predictor of sustained access (OR = 8.63), with households reporting always-available water significantly more likely to sustain service use. Distance to the water source and cost of service do not show statistically significant main effects after governance variables are introduced. Both trust in participatory decision-making and confidence in water governance show statistically significant positive associations with sustained access. The interaction terms between governance and both distance and service availability are statistically significant, indicating that governance conditions shape how service convenience influences household behavior.

The findings suggest that technical convenience alone does not guarantee sustained access. While consistent availability remains crucial, its effect is increased when households trust

governance arrangements. During FGDs, several women mentioned that water interruptions resulted in vandalism; the responsiveness of the management team determined the willingness to continue using the same, but in many instances, the women reported that they had to either do it themselves or hire plumbing services. For instance,

One of the participants noted;

> *Most of the time, when our pipes get damaged, the repairs take so long before the technician is allowed to repair them, until you demand it from the chairman; they don't call us for the meetings to air out our grievances. Could they be calling meetings so that our views could be heard, and I will be able to support the project because I feel it belongs to me. (FGD5)*

This may imply that households could be more willing to tolerate minor inconveniences, such as distance or service interruptions, when they believe that management structures are responsive, accountable, and value the users' opinion.

On the other hand, in low-trust governance contexts, even technically convenient systems experience higher rates of disengagement. This indicates that convenience must be interpreted within a governance framework rather than treated as a purely technical attribute. From a policy perspective, the findings caution against infrastructure-focused interventions that overlook governance reform. The findings of this study are consistent with the study findings of Robeyns (2017), who ascertain that governance not only co-exists with technical factors but also influences households' response towards water availability and conveniences.

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table 4. 16: Moderating effect on quality of service and sustained access

Variable	**(Governance Moderation)**
High Water Quality	2.41** (0.16)
Affordable	1.78 (0.76)
Reliable Piped Water (services)	1.15 (0.54)
High Quality of Service	1.62 (0.82)
Governance (*Main Effects*)	
Trust in Participatory Decision-Making	2.83*** (0.73)
Confidence in Water Governance	3.19*** (0.81)
Interaction Terms	
Quality × Trust	1.92* (0.78)

Quality × Confidence	2.11** (0.83)
Reliability × Trust	1.58* (0.69)
Reliability × Confidence	1.71* (0.74)

*Note: + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$: Source: Field Data (2025)*

Analysis presented in Table 4.16 shows that high perceived water quality remains a statistically significant predictor of sustained access (OR = 2.41), although its effect size is reduced after governance and interaction terms are introduced. Affordability and reliability also show positive but statistically non-significant main effects. Both governance variables show strong and statistically significant associations with sustained access. Interaction effects between governance and water quality, as well as between governance and reliability, are statistically significant. The participants in this study indicated that when governance structures were perceived as transparent and accountable, they were more willing to continue using the service even when occasional water quality or reliability challenges occurred. From the FGD,

One of the participants explained:

> *"At times the piped water is not clean, but because the committee is honest and always informs us about repairs, I will continue using it because I know they are working on it" (FGD3)*

This suggests that governance moderates the influence of service quality on sustained access.

The moderation effects suggest that households' responses to service quality are shaped by their trust in governance structures. In well-governed systems, households appear more tolerant of occasional quality or reliability issues, likely due to expectations of corrective action. Governance therefore acts as a buffering mechanism, stabilizing household expectations and reducing the likelihood of service abandonment in response to short-term quality fluctuations. These findings demonstrate that perceptions of quality are socially constructed and institutionally mediated. Thus, physical characteristics, trust in management and confidence in future service improvement determine the assessment of water quality.

Overall, the qualitative study findings reveal that governance acts as a principal factor that determines whether socio-economic resources are effectively converted into sustainable water service use. In well-governed systems characterized by trust, transparency, and participation, households are more likely to translate their education and income into long-

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term engagement. In contrast, weak governance structures disrupt this relationship, leading to reduced willingness to pay and eventual disengagement from community-managed water services.

4.8 Chapter Summary

This chapter delved in unfolding the research results as well as their interpretation. Its initial section elucidates the influence of various household socio-economic factors on sustained access to service from a community-managed water supply. The findings demonstrate that household socio-economic status (SES) plays a significant role in determining the sustained access to service of community-managed water supply. Households with relatively higher income were more likely to consistently rely on and pay for piped water services managed by the community. In addition, the effectiveness of education and income in supporting sustained use depends on the quality of governance arrangements. Households with higher education levels are significantly more likely to sustain access when they perceive water governance processes as participatory and transparent. Similarly, income-generating households demonstrate higher sustained access when they have confidence in the institutions managing water services. Moreover, households' reliance on community-managed water services indicated that access to service was linked closely to how households engage with and experience various dimensions of service delivery, including financial practices, management accountability, system maintenance, accessibility, and coping strategies. Perceptions of water quality, affordability, service reliability, and the overall quality of service shape household decisions, with some variables showing stronger influence than others. Conveniences of water services, service availability, and cost of service each play unique roles in influencing the sustained access to community-managed water supply, though with varying levels of impact. Over and above that, governance quality functions as a social conversion factor that enables households to translate education and income into sustained water access. In the same vein, social organization and institutional trust are critical to system sustainability.

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CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Chapter Introduction

This chapter presents the summary of findings, conclusions, recommendations, and contribution to knowledge arising from the study that examined household factors influencing sustained access to piped water services from community-managed water supply systems. The chapter synthesizes the major findings in line with the study objectives and draws conclusions from both descriptive and inferential statistical results. Particular attention is given to how household socio-economic characteristics, livelihood-related water use, service convenience, and service quality affect sustained access to community-managed water services. In each of the findings, the research examined whether governance factors moderated the relationship.

The chapter further interprets the implications of the findings for policy, practice, and future research. In doing so, it positions sustained access not merely as the physical presence of water infrastructure, but as a broader outcome shaped by reliability, affordability, water quality, household capacity, livelihood demand, and institutional responsiveness. The chapter therefore provides an integrated basis for understanding the conditions under which

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community-managed water systems are likely to remain functional, equitable, and sustainable over time.

5.2 Summary of Major Findings

5.2.1 Household Socio-economic Characteristics and Sustained Access to Community-Managed Water Supply

The first objective of the study sought to analyze the influence of household socio-economic characteristics on sustained access to piped water services from community-managed water supply systems. The findings established that socio-economic characteristics were significantly associated with sustained access to water services. Specifically, education level was statistically significant at $p = 0.006$, source of income at $p = 0.002$, and marital status at $p = 0.005$. These results indicate that household socio-economic characteristics are not merely descriptive background factors, but important determinants of whether households experience sustained or unsustained access to community-managed water services.

With regard to education level, the findings showed that households with sustained access were mainly represented by respondents with secondary education, accounting for 57.5%, compared to 36% among households with unsustained access. In contrast, respondents with no formal schooling were more represented among households with unsustained access at 12%, compared to only 1.3% among households with sustained access. This pattern suggests that educational attainment may enhance a household's ability to understand water service procedures, comply with payment obligations, participate in community meetings, and engage with water governance structures. Education therefore appears to strengthen the household's capacity to interact meaningfully with the institutional requirements of community-managed water systems.

However, the finding that respondents with education above secondary level were more represented among households with unsustained access, at 22% compared to 10% among those with sustained access, suggests that the relationship between education and sustained access is not entirely linear. This implies that education alone may not guarantee sustained access where other factors such as income stability, service reliability, distance, or quality concerns remain unresolved. Therefore, while education is important, its effect must be understood alongside other socio-economic and service-related conditions.

Source of income also emerged as a significant factor influencing sustained access. Farming was the dominant income source among both categories, but it was substantially higher among households with unsustained access (66%) than among households with sustained access (40%). This finding suggests that households relying heavily on farming may be more

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exposed to seasonal income instability, drought-related shocks, and market fluctuations, which may weaken their ability to meet water tariffs and maintenance contributions consistently. In contrast, households with sustained access were more represented among those employed in non-governmental work, at 16.2% compared to 2%, self-employment, at 16.2% compared to 10%, and daily casual labour, at 8.8% compared to 0%. These figures suggest that households with more diversified or regular income streams may be better positioned to maintain continued access to water services.

Marital status was also significantly associated with sustained access. Although married respondents formed the majority in both categories, at 62.5% among households with sustained access and 58% among those with unsustained access, widowed respondents were disproportionately represented among households with unsustained access. Widowed respondents accounted for 32% of households with unsustained access compared to only 8.8% among households with sustained access. This finding points to the vulnerability of widowed households, who may face reduced income security, limited labour support, and weaker social protection. Such vulnerability may affect their ability to pay for water services, participate in community water governance, or cope with service disruptions.

Overall, the findings under this objective demonstrate that sustained access to community-managed water services is strongly shaped by socio-economic differentiation. Households with stronger educational capacity, more stable income sources, and stronger social support structures appear better able to sustain access. Conversely, households facing educational, economic, or social vulnerability are more likely to experience unsustained access.

5.2.2 Influence of Access to Water for Livelihood Purposes on Sustained Access to Community-Managed Water Supply

The second objective sought to analyze the influence of access to water for livelihood-related purposes on sustained access to community-managed water supply systems. The findings revealed a differentiated relationship between livelihood water use and sustained access. Livestock ownership and watering of vegetables or crops were statistically significant, both at $p < .001$. However, watering animals during the dry season was not statistically significant ($p = 0.447$); the type of vegetables or crops watered was marginal but not significant ($p = 0.055$); and selling piped water for income during the dry season was also not significant ($p = 0.278$). These results suggest that livelihood-related water use influences sustained access selectively, depending on the nature and intensity of the livelihood activity.

Livestock ownership showed a strong association with unsustained access. Among households experiencing unsustained access, 90% kept goats, cows, sheep, or pigs, compared

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to 51.25% among households with sustained access. This large difference suggests that livestock ownership may increase household water demand beyond domestic consumption. In contexts where community-managed systems have limited supply capacity, increased demand for livestock watering may strain the system, contribute to competition among users, and weaken service reliability. The finding therefore implies that livestock keeping may become a pressure factor where water infrastructure was designed mainly for domestic consumption and not for mixed domestic and productive use.

In contrast, household watering of vegetables or crops was more common among households with sustained access. About 74.36% of households with sustained access used water for vegetables or crops, compared to 44% among households with unsustained access. This suggests that reliable water access may enable productive livelihood activities, particularly small-scale crop and vegetable production. The direction of this relationship is important. The finding does not necessarily imply that crop watering causes sustained access; rather, it may indicate that households with more dependable access are better able to use water productively. Sustained access therefore appears to support livelihood diversification, food production, and household resilience.

The study further found that watering animals during the dry season was common across both categories, with 90.24% of households with sustained access and 93.33% of households with unsustained access reporting this practice. Since both groups recorded very high proportions, the difference was not statistically significant. This suggests that dry-season animal watering is a widespread livelihood necessity, regardless of whether households experience sustained or unsustained access.

Similarly, selling piped water for income during the dry season was not significantly associated with sustained access. The practice was reported by 61.25% of households with sustained access and 68% of households with unsustained access. The relatively high proportions in both categories suggest that informal water resale may be a common coping or income-generating strategy, but not necessarily a decisive determinant of sustained access.

Overall, the findings under this objective show that livelihood-related water use is an important but complex factor in community-managed water systems. Productive water use may enhance household resilience where supply is reliable, but it may also increase pressure on the system where demand exceeds capacity.

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5.2.3 Influence of Convenience of Water Service on Sustained Access to Community-Managed Water Supply

The third objective sought to examine the influence of convenience of water service on sustained access to community-managed water supply systems. The findings established that convenience influences sustained access mainly through service availability. Service availability was statistically significant at $p = 0.001$, while distance to source was not significant at $p = 0.290$ and cost of service was not significant at $p = 0.304$. These findings indicate that, among the convenience-related variables examined, continuity and predictability of supply were more important than distance or perceived cost.

The strongest finding concerned service availability. Among households with sustained access, 66.25% reported that water was always available, compared to only 16% among households with unsustained access. Conversely, 84% of households with unsustained access reported that water was rarely available, compared to 33.75% among households with sustained access. This sharp contrast confirms that service availability is central to the meaning of sustained access. A household cannot be said to have sustained access merely because water infrastructure exists nearby; the service must be available consistently and predictably when needed.

The findings further suggest that reliability of supply has practical, social, and financial implications. When water is regularly available, households are more likely to trust the system, pay for the service, plan their domestic and livelihood activities, and remain engaged with the community-managed supply. In contrast, intermittent availability may push households toward alternative sources, reduce confidence in the system, and weaken willingness to contribute to operation and maintenance.

Distance to the water source did not show a statistically significant association with sustained access. Although 52% of households with unsustained access reported that the water source was far away, compared to 42.5% among households with sustained access, the difference was not strong enough to establish statistical significance. This suggests that distance may affect user convenience and satisfaction, but it may not independently determine whether access is sustained. Households may continue using a relatively distant source if the service is dependable, while a nearby source may still fail to support sustained access if water is rarely available.

Cost of service was also not significantly associated with sustained access. Among households with sustained access, 51.25% perceived the cost as high, compared to 42% among households with unsustained access. This finding suggests that households may

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tolerate relatively high water costs where the service is reliable and useful. It also implies that low cost alone does not guarantee sustained access if the service is irregular or unreliable. Therefore, affordability is important, but its effect may depend on whether users perceive value in the service received. Overall, the study established that convenience of service is best understood through reliability and availability rather than distance or cost alone.

5.2.4 Influence of Quality of Water Service on Sustained Access to Community-Managed Water Supply

The fourth objective sought to evaluate the influence of quality-related dimensions of water service on sustained access to community-managed water supply systems. The binary logistic regression results showed that perceived water quality was the strongest and only statistically significant predictor among the quality-related variables examined. Households that perceived water quality as high were 2.793 times more likely to sustain access to community-managed water services than households that perceived water quality as low ($p = 0.009$).

This finding demonstrates that perceived water quality is a critical determinant of sustained access. Households are more likely to remain committed to a water service when the water is perceived as clean, safe, and suitable for domestic use. Conversely, poor perceptions of water quality may discourage continued use even when the infrastructure is physically available. This implies that water quality affects not only household health and satisfaction, but also trust, payment behavior, and continued reliance on the system.

Affordability for domestic use showed a positive but statistically non-significant relationship with sustained access. Households that perceived the service as affordable were 1.871 times more likely to sustain access compared to households that perceived it as unaffordable. However, since the relationship was not statistically significant, affordability cannot be interpreted as an independent predictor in the final model. Nevertheless, the positive direction of the odds ratio suggests that affordability remains practically relevant, especially for low-income households whose ability to remain connected depends on manageable tariffs and predictable payment obligations.

Reliability of piped water also showed a positive but statistically non-significant relationship with sustained access, with an odds ratio of 1.216. This indicates that households perceiving the water supply as more reliable had higher odds of sustained access than those perceiving it as less reliable, although the effect was not statistically significant when other quality-related factors were considered. This result may suggest that some households cope with moderate unreliability through storage, rationing, or supplementary water sources. However, such

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coping strategies should not obscure the importance of reliability as a practical condition for service sustainability.

Overall perceived quality of service also had a positive but statistically non-significant relationship with sustained access, with an odds ratio of 1.919. Although the effect did not attain statistical significance, the direction of the relationship suggests that better service experiences may strengthen household satisfaction and continued use. Elements such as responsiveness to breakdowns, communication from water committees, fairness in service delivery, and accountability in maintenance remain important in shaping household confidence in community-managed water systems.

The findings under this objective therefore demonstrate that water quality is the most decisive quality-related factor influencing sustained access. While affordability, reliability, and overall service quality showed positive associations, their effects were not statistically significant in the final regression model.

5.3 Conclusion

This study examined the household factors influencing sustained access to piped water services from community-managed water supply systems. Drawing from cross-tabulation and binary logistic regression analyses, the study established that sustained access to community-managed water services is shaped by a complex interaction of socio-economic, livelihood, convenience, and service-quality factors. The findings demonstrate that sustained access is not merely a function of the physical existence of water infrastructure, but an outcome influenced by household capacity, livelihood demands, supply reliability, perceptions of water quality, and the broader socio-economic conditions within which households operate.

The study established that household socio-economic characteristics significantly influence whether households experience sustained or unsustained access to water services. Education level, source of income, and marital status all demonstrated statistically significant associations with sustained access. Households with secondary education were more likely to report sustained access, while households with no formal education and widowed households were disproportionately represented among households experiencing unsustained access. Similarly, households relying primarily on farming as their source of livelihood were more likely to experience unsustained access compared to households with diversified income streams such as self-employment, casual labour, and non-governmental employment. These findings suggest that household capacity to sustain access to community-managed water services is strongly shaped by economic stability, educational capability, and social

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resilience. Sustained access therefore reflects broader patterns of socio-economic inequality existing within communities.

The findings further revealed that livelihood-related water use plays a selective but important role in influencing sustained access to water services. Livestock ownership demonstrated a strong association with unsustained access, with households keeping livestock recording substantially higher proportions among households experiencing unsustained access. This finding suggests that livestock production places additional pressure on community-managed water systems, particularly where infrastructure capacity is limited and supply systems are already constrained. In contrast, households using water for watering vegetables or crops were more represented among households with sustained access. This implies that dependable water services support productive livelihood activities and enhance household resilience through small-scale irrigation and food production. The findings therefore demonstrate that community-managed water systems perform both domestic and livelihood functions, and that sustainability challenges emerge where water demand generated by productive activities exceeds system capacity.

The study also established that convenience of water service influences sustained access primarily through service availability and reliability rather than through physical distance or cost alone. Service availability emerged as the only statistically significant convenience-related factor influencing sustained access. Households with sustained access were significantly more likely to report that water services were always available, while households experiencing unsustained access largely reported that water was rarely available. This finding confirms that continuity and predictability of supply are central to the concept of sustained access. Although distance to water source and perceived cost of service influenced household experiences with water collection and affordability, they did not independently determine whether households sustained access to community-managed water services. The findings suggest that households may tolerate relatively longer distances and higher costs where the service remains dependable and consistently available.

With regard to quality-related dimensions of service, the study established that perceived water quality was the strongest predictor of sustained access among the quality variables examined. Households perceiving water quality as high were significantly more likely to sustain access compared to households perceiving water quality as low. This finding underscores the importance of household trust and confidence in the quality and safety of supplied water. Although affordability, reliability of piped water, and overall service quality demonstrated positive relationships with sustained access, their effects did not attain

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statistical significance in the final regression model. Nevertheless, the positive direction of the relationships suggests that affordable tariffs, reliable supply, responsive maintenance systems, and satisfactory service experiences remain important in shaping user satisfaction and continued engagement with community-managed systems.

Overall, the study concludes that sustained access to community-managed water services is multidimensional and cannot be adequately explained through infrastructural availability alone. Instead, sustained access emerges through the interaction between household socio-economic capacity, livelihood water demand, reliability of service delivery, and perceptions regarding water quality and service responsiveness. The findings therefore challenge narrow technocratic approaches that focus primarily on infrastructure provision while overlooking the socio-economic and institutional realities shaping household engagement with water services.

The study further concludes that community-managed water systems operate within contexts characterized by inequality, livelihood vulnerability, and competing water demands. Consequently, households with stronger educational backgrounds, diversified income streams, and greater socio-economic stability are better positioned to sustain engagement with community-managed services. Conversely, economically and socially vulnerable households remain at greater risk of experiencing unsustained access due to limited capacity to cope with unreliable services, tariff obligations, and livelihood-related water pressures.

Within the context of the global discussion and local water sustainability, the study's findings unearth fundamental implications. particularly on the sustainable development (SGD6) goal. that seeks to enhance sustainable access to community-managed water services and sanitation for all. The study reveals that household sustained access goes beyond the provision of infrastructure to requiring attention to socio-economic services reliability, governance quality, and livelihood-sensitive water use. This leads to growing global discourse that water sustainability should be understood not only in technical terms but also through social, equity, and institutional dimensions. The findings of this study provide fundamental policy insight for county governments, water service providers, and community water management committees in Nakuru County, Kenya. The policy enhances rural and peri-urban water access, should strengthen participatory governance, improve accountability mechanisms, stabilize service reliability, and incorporate livelihood water demands into planning and tariff design. In addition, the study suggests that county-level water planning should give priority to vulnerable households, particularly those with low income, limited education, and high dependency. o faming livelihoods to prevent exclusion from sustained access. The findings

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demonstrate how strengthening institutional trust and community participation can significantly improve long-term system functionality and household commitment to community-managed services.

Despite the valuable insights generated by this study, the study experienced some limitations. The study was conducted within a select community-managed water supply system in Nakuru County, Kenya, thereby limiting its generalizability of these findings to other counties or regions with different socio-economic, climatic, and institutional conditions. Further research used a cross-sectional design in a mixed-method design, which has limited ability to observe long-term changes in household access patterns and prevent the establishment of causal relationship between independent variables and sustained access to water services. Longitudinal studies would help us gain a deeper understanding of how households experience and governance conditions evolve over time. Furthermore, the study relied partly on self-reported household perception regarding service quality, affordability, and reliability, which may be influenced by respondent bias or temporary service conditions at the time of data collection. Finally, although the sample size was adequate for statistical analysis.

Finally, the study concludes that long-term sustainability of community-managed water supply systems requires integrated interventions that move beyond physical infrastructure expansion to address household vulnerability, service reliability, water quality assurance, and livelihood-sensitive water governance. Without deliberate efforts to strengthen operational efficiency, improve water quality, accommodate productive water use, and reduce socio-economic inequalities among users, community-managed water systems risk reproducing patterns of exclusion and undermining equitable access to sustainable water services.

5.4 Contribution of the Study to Knowledge

This study contributes to knowledge on sustained access to community-managed water supply systems by advancing empirical, conceptual, methodological, and policy understanding of the factors shaping long-term household engagement with piped water services. While previous studies on community-managed water systems have predominantly focused on infrastructure functionality, technical performance, or governance arrangements in isolation, the present study demonstrates that sustained access is a multidimensional outcome shaped by the interaction between household socio-economic characteristics, livelihood-related water use, service convenience, and quality-related service experiences. The study therefore broadens the analytical understanding of sustainability in community-managed water systems beyond narrow engineering and service delivery perspectives.

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First, the study contributes empirical knowledge by demonstrating that household socio-economic characteristics significantly shape sustained access to community-managed water services. The findings established statistically significant associations between education level ($p = 0.006$), source of income ($p = 0.002$), and marital status ($p = 0.005$) with sustained access to service. These findings contribute to existing literature by showing that sustained access is socially differentiated and unequally experienced across households. The study therefore challenges assumptions that community-managed systems automatically produce equitable access outcomes once infrastructure has been established. Instead, the findings demonstrate that households with stronger educational capacity, diversified income streams, and stronger social support systems possess greater ability to sustain access compared to economically and socially vulnerable households.

The study further contributes to knowledge by demonstrating that educational attainment influences sustained access not merely through literacy, but through enhanced capacity to engage with institutional and governance dimensions of water management. Households with secondary education were more represented among households with sustained access, while households with no formal education were disproportionately represented among households with unsustained access. This finding advances existing understanding by showing that education strengthens household capacity to understand tariff systems, participate in collective management structures, engage in accountability processes, and comply with operational requirements of community-managed systems. In this regard, the study contributes to emerging debates linking water sustainability with social capability and institutional participation.

A second major contribution of the study lies in its examination of livelihood-related water use as a determinant of sustained access. Existing studies on community-managed water systems have largely concentrated on domestic water use while giving limited attention to the productive functions of water at the household level. This study contributes new evidence showing that livelihood-oriented uses of water selectively influence sustainability outcomes. The findings established that livestock ownership was strongly associated with unsustained access, while watering vegetables or crops was positively associated with sustained access. These findings contribute to knowledge by demonstrating that community-managed water systems simultaneously function as domestic and livelihood-support systems. The study therefore expands understanding of sustainability by illustrating how productive water use

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may either strengthen household resilience or intensify pressure on constrained systems depending on the scale and nature of water demand.

The findings on livestock ownership make an important conceptual contribution by illustrating how livelihood dependency can become a source of stress within community-managed systems where infrastructure capacity remains limited. Households keeping livestock recorded substantially higher proportions among households experiencing unsustained access, suggesting that productive water demands may undermine continuity of service where systems are not designed to accommodate mixed domestic and livelihood needs. At the same time, the finding that households watering vegetables or crops were more represented among households with sustained access contributes to understanding how reliable water supply enhances livelihood diversification, household food security, and resilience. The study therefore demonstrates that sustainability of water systems cannot be separated from the livelihood realities of users.

Third, the study contributes to knowledge on convenience of service by demonstrating that continuity and predictability of supply are more critical to sustained access than physical proximity or affordability alone. While existing literature frequently treats convenience in terms of distance to water source, the findings of this study reveal that service availability constituted the only statistically significant convenience-related variable influencing sustained access ($p = 0.001$). In contrast, distance to source and cost of service did not demonstrate statistically significant associations with sustained access. This finding contributes to theoretical and practical understanding of sustained access by showing that households prioritize reliability and continuity of service over physical convenience alone. The study therefore shifts analytical attention from simplistic measures of proximity toward broader dimensions of operational reliability and service functionality.

The finding that households may tolerate relatively longer distances and higher costs where services remain dependable contributes important insights into household decision-making and service valuation within community-managed systems. This challenges conventional assumptions that proximity and affordability alone determine sustained use. Instead, the study demonstrates that continuity of supply forms the foundation upon which user trust, willingness to pay, and long-term engagement with water systems are built.

Fourth, the study makes a significant contribution to knowledge regarding quality-related dimensions of community-managed water services. The binary logistic regression analysis established that perceived water quality was the strongest and only statistically significant quality-related predictor of sustained access, with households perceiving water quality as

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high being approximately 2.793 times more likely to sustain access compared to households perceiving water quality as low. This finding contributes to existing literature by demonstrating that household perceptions of safety, cleanliness, and suitability are central determinants of sustained engagement with community-managed systems.

The study therefore advances understanding of water quality beyond technical compliance indicators by emphasizing the role of user perceptions in shaping household trust and continued reliance on water services. Even where infrastructure remains operational, poor perceptions of water quality may discourage sustained use and undermine willingness to continue paying for services. In this regard, the study contributes to broader debates on user-centered service delivery and the relationship between service quality perceptions and sustainability outcomes.

Methodologically, the study contributes to knowledge by integrating cross-tabulation analysis and binary logistic regression to examine determinants of sustained access. Cross-tabulation identified significant household-level associations, while binary logistic regression examined the relative influence of quality-related variables on sustained access outcomes. This analytical combination strengthened the robustness of the findings and enabled the study to move beyond descriptive analysis toward explanatory understanding of sustainability determinants.

The study also contributes to policy and practice by demonstrating that sustainability of community-managed water systems requires integrated rather than purely technical interventions. The findings reveal that infrastructure provision alone is insufficient to guarantee sustained access where socio-economic inequalities, livelihood pressures, unreliable supply, and concerns regarding water quality remain unresolved. Consequently, the study contributes evidence supporting more holistic approaches to water governance that integrate social protection, livelihood-sensitive planning, operational reliability, and quality assurance within community-managed systems.

Finally, the study contributes to the broader discourse on sustainable development and equitable service delivery by demonstrating that sustained access to water services is closely linked to social inequality, household vulnerability, and institutional responsiveness. The findings show that community-managed systems may unintentionally reproduce inequalities where vulnerable households lack the economic and social capacity required to sustain engagement with services. The study therefore contributes to ongoing debates on equity and

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inclusion within decentralized water governance frameworks and provides evidence for the need to strengthen pro-poor approaches in community-managed water supply systems.

The study contributes significantly to Sustainable Development Goal (SDG) knowledge, particularly SDG 6 on clean water and sanitation, by demonstrating that physical availability of water infrastructure alone does not guarantee sustained access to safe and reliable water services. The findings show that the sustainability of access is strongly influenced by household socio-economic capacity, livelihood demands, supply reliability, and perceptions of water quality, thereby advancing the understanding that sustainable water access requires not only infrastructural investment but also supportive socio-economic and institutional conditions. The study further contributes to broader sustainable development discourse by illustrating the interconnectedness between water access and multiple SDGs, including SDG 1 on poverty reduction, SDG 2 on food security, SDG 3 on health and well-being, SDG 5 on gender equality, and SDG 10 on reduced inequalities. Households with unstable income streams and greater social vulnerability were more likely to experience unsustained access, while reliable water access supported livelihood diversification, household resilience, and small-scale agricultural production. Additionally, the finding that perceived water quality significantly influenced sustained access reinforces the relationship between safe water, public health confidence, and long-term utilization of water systems. The study therefore contributes evidence that sustainable community-managed water systems must address social inequality, livelihood realities, and institutional responsiveness alongside physical infrastructure provision.

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5.4 Study Recommendations

5.4 Recommendations introduction

The findings of this study demonstrate that sustained access to community-managed water services is influenced by a complex interaction of socio-economic conditions, livelihood-related water demand, service reliability, and perceptions regarding water quality. Based on these findings, the study proposes the following policy, practice, and research recommendations aimed at strengthening long-term sustainability, equity, and effectiveness of community-managed water supply systems.

5.4.1 Implication for Policy and Practice

The findings of this study have significant implications for water governance policy and practice at both national and county level, as well as within the broader international agenda

on sustainable water services delivery, specifically Sustainable Development Goal 6 on clean water and sanitation. The study revealed that sustained access to community-managed water services is determined not only by infrastructure provisions but by an interconnected system of socio-economic factors, governance quality, service reliability, livelihood dependence, and perceived water quality. These findings call for a shift in water policy from a purely infrastructure approach to an integrated service delivery and governance-centered approach.

At the county and National level, the results imply that water sector planning within Kenya, including the frameworks under the water Act 2016 and county integrated Development plans, should prioritize governance strengthening alongside infrastructure expansion.in he local level (Nakuru, County) where disparities in access are influenced by income levels, education and livelihood aspect, policy should explicitly incorporate pro-poor targeting mechanism with in water service delivery. This includes subsidized tariff structures for vulnerable households, particularly widowed and low-income farming households, as well as introducing flexible payment systems during drought and periods of economic stress. These measures would enhance equity in access and reduce exclusion within community-managed water systems.

Their study further contributes to the implementation of SDG 6 by highlighting that universal access cannot be achieved without considering reliability, affordability, and governance responsiveness. Although global policy frameworks emphasize infrastructure coverage, the findings from this study demonstrate that sustainability depends equally on institutional trust, service continuity, and user satisfaction. Therefore, SDG 6 implementation strategies should integrate governance performance indicators such as accountability of water committees, participation rates in decision-making, and responsiveness to user complaints as key measures of progress, in addition to physical access indicators.

Further, the findings suggest that the county government and water sector stakeholders should pilot integrated community governance model that combine pilot program in selected wards where water committee are strengthened through structured training, mentorship by technical officers and a standardized reporting system linked to county water departments these pilots would also incorporate digital feedback platforms such as SMS-based reporting systems, to enhance communication between households and water committees, lessons from such pilots could then be scaled across other rural and peri-urban areas.

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In addition, the results reveal that water quality monitoring should be institutionalized as a routine function rather than an external intervention. The county water departments should collaborate with community water committees to establish localized water testing points, periodic quality reporting, and a rapid response mechanism for contamination risks. It strengthens public trust in the water system and increases sustained household engagement.

At the global level, these study findings will reinforce international evidence that community-managed water systems require a strong governance ecosystem to remain sustainable. The results support the argument that achieving SDG 6 requires not only infrastructure expansion but also investment in institutional capacity, socio-inclusivity, and user-management accountability mechanisms. The findings, therefore, contribute to global discussion on water governance by demonstrating that household factors, combined with governance quality, determine long-term sustainability outcomes in low-income countries.

5.4.2 Policy Recommendations

The study established that household socio-economic characteristics significantly influence sustained access to community-managed water services, with education level ($p = 0.006$), source of income ($p = 0.002$), and marital status ($p = 0.005$) all demonstrating statistically significant associations with sustained access. In particular, widowed households and households dependent primarily on farming were disproportionately represented among households experiencing unsustained access. Based on these findings, the study recommends that the Nakuru County Government, in collaboration with water sector stakeholders and community-managed water committees, develop targeted pro-poor water support mechanisms for socially and economically vulnerable households. Such interventions may include subsidized tariffs for vulnerable households, flexible payment arrangements during drought periods, and social protection measures aimed at supporting widowed and low-income households to maintain continuous engagement with community-managed water systems.

The study further recommends that county governments and community-managed water committees integrate livelihood-sensitive planning into community water governance frameworks. The findings showed that livestock ownership was strongly associated with unsustained access, while productive uses such as watering vegetables and crops were positively associated with sustained access. These findings imply that community-managed systems are increasingly required to support both domestic and livelihood water needs. Consequently, future planning and infrastructure development should incorporate productive

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water demand considerations, particularly in rural and peri-urban areas where household livelihoods depend heavily on livestock keeping and small-scale crop production. This may involve expanding storage facilities, developing supplementary water sources for livestock, and implementing differentiated water allocation systems during periods of scarcity.

The findings established that service availability was the strongest convenience-related determinant of sustained access, with households experiencing sustained access being significantly more likely to report that water services were always available. Based on this finding, the study recommends that Nakuru County Government, water service providers, and community-managed water committees prioritize operational reliability and continuity of supply within community-managed systems. Particular emphasis should be placed on preventive maintenance, timely repair of breakdowns, protection of water sources, and investment in infrastructure resilience. Community-managed systems should move beyond reactive maintenance approaches toward planned operational management systems capable of minimizing service interruptions.

The study also established that perceived water quality was the strongest and only statistically significant quality-related predictor of sustained access, with households perceiving water quality as high being approximately 2.793 times more likely to sustain access compared to households perceiving water quality as low. The study therefore recommends that community-managed water committees and relevant county health and water authorities institutionalize routine water quality surveillance systems. Such systems should include periodic water testing, transparent dissemination of water quality information to users, regular cleaning and maintenance of water infrastructure, and rapid response mechanisms where contamination or quality concerns arise. Strengthening household confidence in the safety and quality of supplied water is critical for sustaining long-term use and willingness to continue supporting community-managed systems financially and institutionally.

Further, the study recommends that community-managed water governance structures strengthen participatory and inclusive management approaches. Although the study focused primarily on household factors, the findings consistently demonstrated that sustained access is influenced by household capacity to engage with institutional processes and management structures. Therefore, community water committees should strengthen transparency, accountability, and user participation in tariff setting, maintenance planning, conflict resolution, and decision-making processes. Special attention should be given to enhancing participation among socially vulnerable households, women, widowed persons, and

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households with lower educational attainment in order to reduce exclusion within community-managed systems.

Community-managed water systems committees at the operational level should be structured with clearly defined roles, including a chairperson responsible for oversight, a treasurer responsible for transparent financial management, the technical officer responsible for infrastructure monitoring, and a community liaison officer responsible for simplified financial reports to service users on a quarterly basis. Accountability should be enforced through mandatory public disclosure of income and expenditure at water points, with oversight provided by sub-County water officers to ensure compliance and replace non-performing committee members where necessary. In the context of Nakuru County, implementation of these recommendations must consider persistent challenges such as recurrent drought in rural wards and unequal infrastructure distribution between rural and peri-urban areas. Limited technical and financial capacity at the sub-county level. In some areas, these committees influence political dynamics during selection and allocation processes, which can weaken accountability. Thereby, strengthening water governance must be accompanied by a depolarized committee selection process targeting infrastructure investment in underserved wads and increased deployment of county technical officers to support rural community-managed systems.

5.4.3 Practice Recommendations

At the practice level, the study recommends that community-managed water committees undertake continuous household sensitization programs focusing on water governance, tariff compliance, household water conservation practices, and preventive maintenance responsibilities. Since educational attainment significantly influenced sustained access, sensitization programs should particularly target households with lower educational levels to strengthen understanding of water management procedures and encourage active participation in governance processes.

The study also recommends strengthening household-level water storage and conservation initiatives through community-managed water systems. The findings demonstrated that households may adopt coping mechanisms during periods of supply interruption. Promoting affordable household water storage technologies, rainwater harvesting practices, and water conservation strategies would help reduce vulnerability during temporary interruptions and enhance household resilience.

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Further, the study recommends that community-managed water committees establish clearer operational guidelines regarding productive water use, particularly livestock watering and informal water resale activities. Since productive water demands may strain limited systems, clear governance arrangements are necessary to balance domestic water needs with livelihood-related uses while minimizing conflict and system overload.

Additionally, the study recommends that community-managed systems strengthen monitoring and record-keeping mechanisms related to service interruptions, user complaints, water quality concerns, and infrastructure performance. Improved monitoring systems would support evidence-based maintenance planning, enhance accountability, and facilitate early identification of operational challenges affecting sustained access.

5.4.4 Recommendations for Further Research

This study focused on household factors influencing sustained access to community-managed water services within selected contexts. Future studies should therefore examine the influence of institutional and governance factors on sustained access using longitudinal and comparative research designs. Such studies would provide a deeper understanding of how governance quality, leadership effectiveness, and accountability mechanisms shape long-term sustainability outcomes.

Further research should also investigate gender dimensions of sustained access to community-managed water systems. Although this study identified vulnerability among widowed households, gender was not analyzed as an independent variable. Future studies should therefore explore how gender relations, household labour responsibilities, and decision-making dynamics influence sustained access to water services.

The study additionally recommends further research on the long-term implications of productive water use within community-managed systems, particularly the relationship between livestock-related water demand, infrastructure pressure, and sustainability outcomes under conditions of increasing climate variability and water scarcity.

Finally, future studies should examine the effects of climate change, drought frequency, and environmental degradation on the sustainability of community-managed water systems, particularly within rural and peri-urban areas where household livelihoods remain heavily dependent on water-sensitive economic activities.

Further research should specifically examine the relationship between water governance structures and community participation in decision-making within water systems. In particular, special attention should be given to how household socio-economic characteristics,

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institutional design, and leadership accountability influence the quality of engagement in planning, tariff settings, and maintenance decisions. Further, future studies should explore the effectiveness of community-managed monitoring and feedback mechanisms in improving transparency, responsiveness, and long-term sustainability of water services in peri-urban and rural contexts such as Nakuru County. Future studies could address more specific empirical questions and testable hypotheses. For instance, how do water governance structures influence household participation in community-managed water systems? What roles do community-managed water services and effective feedback mechanisms play in significantly improving perceived reliability and willingness to pay for water services?

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APPENDIX 1: CONSENT FORM FOR PARTICIPATION IN QUESTIONNAIRE

A: INTRODUCTORY INFORMATION

A1: ORAL CONSENT SCRIPT

Dear Respondent,

My name is Joel Kinyanjui Njoroge, a PhD student at St. Paul's University Limuru Campus (PDSNKR517118). I am currently conducting research for my doctoral thesis titled "Households Factors Associated with Community-managed Water Service sustained access to service: A Case Study of Nakuru County, Kenya.". The study examines the households' sustained access to service of community-managed water services and the factors influencing it. I kindly invite you to fill the questionnaire attached to assist me in generating data for my thesis. The study was approved by NACOSTI and the necessary clearance was

obtained. It is my humble request that you to answer the questions as sincerely as possible. The information you will give will only be used for research purposes and your identity will be treated with utmost confidentiality. All data collected will be synthesized into a report.

In case you require further clarification about this study you may conduct me through Tel:0719622899 or Email: eleftherios05@gmail.com

Yours truly,



Joel Kinyanjui Njoroge

Consent approval Tick _____

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APPENDIX 2: QUESTIONNAIRE FOR PIPED WATER COMMUNITY-MANAGED PIPED SERVICES HOUSEHOLDS

SECTION A: HOUSEHOLD STATUS

Questionnaire Number	DATE and TIME
Name of WARD	
Name of Sub-location	
Name of Village	
Name of Community Water Project	
Year when Community Water Project Started Providing Piped Water to beneficiaries	

Gender of the respondent	Male Female
Respondent Community Water Service beneficiary type	TICK ONE
	1) Piped to household 2) Household Collects Water from the Community-Public water service
If piped to household beneficiary, which year did the household begin enjoying piped-to-household water Service?	
How would you describe your household proximity to a tarmac- or murram road?	(TICK ONE)
	• Very close to a tarmac- or murram road • Slightly far from a tarmac- or murram road • Very far from tarmac- or murram road

Participants Socio-demographic status

1: Is your household residential in town?	• Yes	
	• No	
2: Age of the respondent (in years)_____or Year of birth?		
3: Marital status	(tick appropriately)	
	• Single	
	• Married	
	• Separated	
	• Divorced	
	• Widowed	
4: What is the highest education level the	Tick appropriately	
	• No formal schooling	

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head of household has completed?	• Primary	
	• Secondary	
	• Greater than secondary	
5: How many people in TOTAL, including you, currently live in your household?	_____people	
6: Composition of Household Members by number		
a. Number of infants – Aged Less than 5 years		
b. Number members 5-18years(Teens)		
c. Number of members – 19-35yrs(youths)		
d. Number of members – 36-59years(Adults)		
7: What are the main Sources of INCOME of this household? (tick all that apply)	YES	No
• Farming		
• Business		
• Employed by Government/Gov't Agencies		
• Employed in Non-Gov't Agencies		
• Daily labour (including casuals paid on a daily wage)		
• Self-employed		
• Remittances		

SECTION B: HOUSEHOLD'S PIPED WATER USE-CHARACTERISTICS Dv

A: Sources of water for household domestic use & other uses during the dry season months

A: The Main Source of Drinking Water during the dry season	**Tick one**

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8: What is your Main **DRINKING** water source **DURING THE DRY SEASON MONTHS**?	▪ Piped to household ▪ Piped to compound ▪ Public water service ▪ Shallow-Well ▪ Hand pump ▪ Water Spring ▪ Dam/Pan/River/Lake ▪ Vendor/Bottled water ▪ Harvested Rain Water ▪ Others (specify) _____
9: Why do you rely on this as the main **DRINKING** water source during dry season?	_____ _____
10: What are the other sources of **DRINKING** water during the dry season?	_____ _____
11: What are the reasons for you to use the water for **DRINKING** from these other sources?	_____ _____
Main Source of BATHING Water during the dry season	**(tick one)**
12: What is your main source of **BATHING** water during the Dry season?	▪ Piped to household ▪ Piped to household ▪ Piped to compound ▪ Public water service ▪ Shallow-Well ▪ Hand pump ▪ Water Spring ▪ Dam/Pan/River/Lake ▪ Vendor/Bottled water ▪ Harvested Rain Water ▪ Others (specify)Others (specify)_____
13: Why do you RELY on this water source for **BATHING** during the dry season?	_____ _____

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14: What are the other sources of **BATHING** water for your household during the dry season?	_____ _____
15: What are the reasons for you to use the water for **BATHING** from these other sources?	_____ _____
Main Source of COOKING Water during the dry season	**Tick appropriately**
16: What is your main source of water for **COOKING** DURING THE DRY SEASON MONTHS?	▪ Piped to household ▪ Piped to compound ▪ Public water service ▪ Shallow-Well ▪ Hand pump ▪ Water Spring ▪ Dam/Pan/River/Lake ▪ Vendor/Bottled water ▪ Harvested Rain Water ▪ Others (specify)_____
17: Why do you rely on this source for **COOKING** water during the dry season?	_____ _____
18: What are the other sources of **COOKING** water during the dry season?	_____ _____
19: What are the reasons for you to use the water for **COOKING** from these other sources?	_____ _____
20: Main Source of WASHING CLOTHES and	**Tick appropriately**

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LAUNDRY Water during the dry season	
21: What is your main source of **WASHING CLOTHES** and **LAUNDRY** water DURING THE DRY SEASON MONTHS?	▪ Piped to household ▪ Piped to compound ▪ Public water service ▪ Shallow-Well ▪ Hand pump ▪ Water Spring ▪ Dam/Pan/River/Lake ▪ Vendor/Bottled water ▪ Harvested Rain Water ▪ Others (specify)_____
22: Why do you rely on this source for **WASHING CLOTHES and LAUNDRY** during dry season?	_____ _____
23: What are the other sources of **WASHING CLOTHES and LAUNDRY** water during the dry season?	_____ _____
24: What are the reasons for you to use the water for **WASHING CLOTHES and LAUNDRY** from these other sources?	_____ _____
25: DOES the household KEEP any of the following livestock? (Cattle, Pigs, Goats, Sheep)	• YES • NO
26: IF YES, what is your main source of water for these LIVESTOCK during the dry	▪ Piped to household ▪ Piped to compound ▪ Public water service ▪ Shallow-Well ▪ Hand pump ▪ Water Spring

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season months?	▪ Dam/Pan/River/Lake ▪ Vendor/Bottled water ▪ Harvested Rain Water ▪ Others (specify)_____
27: Why do you use this as your source **of WATERING LIVESTOCK during the** dry season?	_____ _____
28: What are the other sources of **WATERING LIVESTOCK** water during the dry season?	_____ _____
29: Does your household have a KITCHEN GARDEN?	**YES** **NO**
30: Main Source of watering vegetables in the dry season	**Tick appropriately**
31: IF YES, what is your main source of watering vegetables during the dry season months?	▪ Piped to household ▪ Piped to compound ▪ Public water service ▪ Shallow-Well ▪ Hand pump ▪ Water Spring ▪ Dam/Pan/River/Lake ▪ Vendor/Bottled water ▪ Harvested Rain Water ▪ Others (specify) _____
32: What is the reason for you to use the **WATERING VEGETABLES** water from these other sources?	_____ _____
33: Why do you rely on this	_____ _____

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water source for **WATERING VEGETABLES** water source during dry season?	
34: What are the other sources of **WATERING VEGETABLES** water during the dry season?	_____ _____
35: What are the reasons for you to use the water for **WATERING VEGETABLES** from these other sources during the dry season?	_____ _____

SECTION C: SOURCES OF WATER FOR HOUSEHOLD DOMESTIC USE & OTHER USES DURING THE RAIN SEASON MONTHS

36: The Main Source of Drinking Water during the RAINY season	**(TICK ONE)**
37: What is your Main DRINKING water during the RAIN Season Months?	▪ Piped to household ▪ Piped to compound ▪ Public water service ▪ Shallow-Well ▪ Hand pump ▪ Water Spring ▪ Dam/Pan/River/Lake ▪ Vendor/Bottled water ▪ Harvested Rain Water ▪ Others (specify) _____
38: Why do rely on this as the main source for **DRINKING** water during the RAIN Season Months?	_____ _____
39: What are the other sources of	_____ _____

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DRINKING water during the RAIN Season Months?	
40: What are the reasons for you to use the water for **DRINKING** from these other sources during the RAIN Season Months?	_____ _____
41: Household water main source for BATHING during the rainy season	**TICK ONE**
42: What is your main source of **BATHING** water during the RAIN Season Months?	☐ Piped to household ☐ Piped to compound ☐ Public water service ☐ Shallow-Well ☐ Hand pump ☐ Water Spring ☐ Dam/Pan/River/Lake ☐ Vendor/Bottled water ☐ Harvested Rain Water ☐ Others (specify) _____
43: Why do rely on this as the main source for **BATHING** water during the RAIN Season Months?	_____
44: What are the other sources of **BATHING** water during the RAIN Season Months?	_____
45: What are the reasons for you to use the water for **BATHING** from these other sources rainy	_____ _____

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season?	
46: Household water main source for COOKING DURING the rainy season	**TICK ONE**
47: What is your main source of **COOKING** water during the RAIN Season Months?	• Piped to household • Piped to compound • Public water service • Shallow-Well • Hand pump • Water Spring • Dam/Pan/River/Lake • Vendor/Bottled water • Harvested Rain Water • Others (specify) _____
48: Why do you rely on this as the main **COOKING** water source during the RAIN Season Months?	_____ _____
49: What are the other sources of **COOKING** water during the RAIN Season Months?	
50: What are the reasons for you to use the water for **COOKING** from these other sources during the RAIN Season Months?	_____ _____
51: Main Source of WASHING CLOTHES and LAUNDRY Water during the dry season	**TICK ONE**

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52: What is your main source water for **WASHING CLOTHES** and **LAUNDRY** during the RAIN Season Months?	• Piped to household • Piped to compound • Public water service • Shallow-Well • Hand pump • Water Spring • Dam/Pan/River/Lake • Vendor/Bottled water • Harvested Rain Water • Others (specify)_____
53: Why do you rely on this source for **WASHING CLOTHES and LAUNDRY** water source during dry season?	_____ _____
54: What are the other sources of **WASHING CLOTHES and LAUNDRY** water during the RAIN Season Months?	_____ _____
55: What are the reason for you to use the water for **WASHING CLOTHES and LAUNDRY** from these other sources?	_____ _____
56: Household water main source for WATERING LIVESTOCK during the rainy season	**TICK ONE**
57: What is your main source of water for **LIVESTOCK** during the RAIN Season	• Piped to household • Piped to compound • Public water service • Shallow-Well • Hand pump • Water Spring

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Months?	• Dam/Pan/River/Lake • Vendor/Bottled water • Harvested Rain Water • Others (specify)_____
58: Why do you rely on this as the main source for **LIVESTOCK WATERING** during the RAIN Season Months?	_____ _____
59: What are the other sources for **WATERING LIVESTOCK** during RAIN Season Months?	_____ _____
60: What are the reasons for you to use these other sources for **WATERING LIVESTOCK** RAIN Season Months?	_____ _____
61: Household water main source WATERING VEGETABLES the rainy season	**TICK ONE**
62: What is your main source for **WATERING VEGETABLES** water during the RAIN Season Months?	• Piped to household • Piped to compound • Public water service • Shallow-Well • Hand pump • Water Spring • Dam/Pan/River/Lake • Vendor/Bottled water • Harvested Rain Water • Others (specify)_____
63: Why do you rely on this as the main source for **WATERING**	_____ _____

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VEGETABLES water source RAIN Season Months?		
64: What are the other sources of **WATERING VEGETABLES** water RAIN Season Months?	_____ _____	
65: What are the reasons for you to use the water for **WATERING VEGETABLES** from these other sources RAIN Season Months?	_____ _____	
66: If your household has piped water, is the water running NOW ?	• Yes	
	• No	
67: If your household has piped water, has the water been running for the last 7 days?	• Yes	
	• No	
68: If your household has piped water, has the water been running for the last 1 month?	• Yes	
	• No	
69: If your household has piped water, is your supply metered?	• Yes	
	• No	
70: If your household has piped water, what are the monthly bills during the dry season in a	_____**sh**	

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month?	
71: If your household has piped water, what are the monthly bills during the rainy season in a month?	_____**Ksh**

SECTION D: GOVERNANCE OF COMMUNITY-MANAGED WATER SUPPLY

72: Is your drinking piped water supply functioning now?	• Yes, functioning well	
	• Yes, functioning but not well	
	• No, not functioning	
73: How many hours per day is your piped water supply available?	----------Hours	
74: How many days in a week is your piped water supply available?	----------days	
75: on average what would you estimate to be your monthly income?		
76: on average how much money does your household spend per month paying for water during the dry season?		

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77: on average how much money does your household spend per month paying for water during the rainy season?			
Satisfaction with the Amounts Paid for piped water services	Satisfied (3)	Dissatisfied (2)	Very Dissatisfied (1)
78: How satisfied are you with the amounts you pay to access piped water services**?**			
Rank how you agree or disagree with the following water bills Payment	Agree 3	Disagree 2	Strongly Disagree1
79: I have never had my water service disconnected due to delays in paying monthly bills.			
80: Am always paying water bill during the			

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rainy season on time.				
82: I am always paying my water bill on time during the dry season on time**.**				
83: The cost of Pipes and other materials needed to connect to the water supply is affordable.				
84: I have no major difficulties raising the money required to pay for piped-to household water services.				
	Strongly agree 4	Agree 3	Disagree 2	Strongly disagree 1
85: Water fees are regularly collected				
86: Households receive official receipts after water fee payment				
87: Both peri-urban are charged fairly and uniformly				

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for water service				
88: There are clear communication on revenue collection and usage				
89: my household is satisfied with the accountability in revenue collection				

90: Before you switched to Community-based Piped Water Services, what were your **THREE main** Sources of Water for Domestic Uses (Drinking, Cooking, and Washing)? **(Record Response)**

_____
_____
_____

91: What challenges did your household experience with these Sources of Water?

_____
_____
_____

92: What are the benefits that WOMEN from households with access to Piped water services enjoy?

_____
_____
_____

93: What are the benefits that CHILDREN from households with access to Piped water services enjoyed?

_____
_____
_____

94: About how much money does your household pay for the Community-managed Piped water service in any month during DRY Seasons months? _____shs

95: About how much money does your household pay for the Community-Managed Piped water service in any month during RAINY Season Months? _____shs

96: How much did your household pay for piped water services LAST MONTH? _____shs

97: what is the method of payment for water? _____

Daily Operations and Maintenance of piped water supply	**Yes**	**No**
98: Is there a technician/plumber to look after your main drinking piped water supply?		

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99: Do you know whether the technician/plumber is paid on work done by the committee?		
100: Is there a scout who patrols to check vandalism along the piping of your main water source?		
101: Is there a water committee that is responsible for management of the piped water supply?		
102: Is there a committee is responsible for maintenance of the piped water system?		
103: Is there a committee is responsible for coordinating repairs of the piped water system?		
104: Is there committee is responsible for regulating the monthly water tariff?		

SECTION E: CONVENIENCE OF COMMUNITY-MANAGED WATER SERVICE

105: Since connection to the main household-piped water services, has your household ever been disconnected from the main pipe system?	Yes No
106: If yes what were the reasons for the disconnection?	_____ _____ _____
107: How long did it take to be reconnected?	
108: Have you been disconnected in the last three months?	Yes No
109: What were the reasons that lead to your household disconnection?	_____ _____ _____
110: As a results of disconnection what inconveniences did you house experience?	_____ _____ _____ _____
111: How much did you have to pay for a reconnection?	_____sh
112: Where did your household obtain water from during the period of disconnection?	_____ _____ _____
113: How much do you pay for piped water service each	_____sh

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month during the Dry season?	
114: Is the amount of money paid for the piped water used the same during the dry season and also during the rainy season?	Yes No
115: If the amount is different how huge is the difference?	_____sh
116: If the amount is different why?	_____
117: On average days in a week is the piped water supply available?	
118: How many hours in a day is piped water service available?	
119: Has your water system ever been disrupted?	
120: Is the water services from the community water services available during the water season**?**	

SECTION F: QUALITY OF SERVICES FROM A COMMUNITY-MANAGED WATER SUPPLY

121: How reliable is piped water service during the dry season?	• **Very reliable** • **Somewhat reliable** • **Unreliable** • **Very unreliable**			
122: How reliable is piped water service during the rainy season?	• **Very reliable** • **Somewhat reliable** • **Unreliable** • **Very unreliable**			
Rank the following statements	**Strongly Agree 4**	**Agree 3**	**Somewhat Disagree 2**	**Strongly Disagree 1**
123: The money required from me to pay for connection is affordable.				
124: I have no major difficulties raising the money required to pay for water connection.				
125: I have no major difficulties raising the money required to pay for piped-to household water services.				

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126: The money required from me to pay for the piped water regular service or monthly bill is affordable.				
127: I have no major difficulties paying the Monthly service fees for water supply.				
128: I had no challenges raising money to pay people to dig trenches for water pipes.				
130: Am always paying water bill during the rainy season.				
131: Are you concerned about the safety of water from your piped source?	Yes			
	No			
132: If yes what are safety concerns?	----------			
133: Do you think water from your piped water service is safe for drinking?				
134: If you think that the water from your piped water services is NOT safe for drinking, please explain?	----------			
135: On average what would you estimate to be your monthly income?				
136: On average how much money does your household spend per month paying for water during the dry season?				
137: On average how much money does your household spend per				

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month paying for water during the rainy season?				
138: Rank how satisfied or dissatisfied are you with the following Payment arrangements for piped water services	Very Satisfied (4)	Satisfied (3)	Dissatisfied (2)	Very Dissatified (1)
139: Paying flat rate on a monthly basis before use.				
140: Paying according to water consumed according to water meter reading.				
141: Paying as you collect based on the size of your container.				
How Satisfied are you with the Piped Water Tariffs and related arrangements, described by each of the statement below:				
142: I am rarely behind with payment of Monthly service charge.				
143: I had no major difficulties raising money to meet the cost of materials and pipes for connection to the water supply.				
144: I have no major difficulties paying the Monthly service fees for water supply.				
145: I have never had my water service disconnected due to delays in paying monthly bills				
146: Is your main drinking piped water source functioning NOW?	• Yes	No		

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147: How confident are you that your piped water supply will be functional FIVE-YEARS from now?	very confident	Somewhat confident	Not at all confident	
148: IF you are NOT sure that the Community-piped water services will not be functioning during the next 5 years, what are the reasons why you think so?	_____ _____			
149: In the last 6 months, was there any times when piped water service was not available for more than one week?	• Yes	No		
150: How many days did the interruption last?	----------days			
Satisfaction with the Amounts Paid for piped water services	Very Satisfied (4)	Satisfied (3)	Dissatisfied (2)	Very Dissatisfied (1)
151: How satisfied are you with the amounts you pay to access piped water services?				

SECTION E(III): DISRUPTION OF PIPED WATER SERVICES		
152: Was there a time when you have not had water because there is disruption such as pipe burst and pipe vandalism?	Yes	
	No	
153: When did the disruption occur?	----------	
154: How long did it take before there piped water services were restored?	----------	
155: Who paid for the replacement of the burst pipes?	----------	

SECTION F: BENEFICIARY PARTICIPATION IN SET-UP OF PIPED WATER SERVICES		
SECTION F(I): Contributions Towards Water Source Establishment		
156: Did your household make any form of contribution to have	**Yes**	

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water piped to household?	**No**	
	Tick appropriately	
157: If yes what were the forms of contribution?	• Labour	
	• Money	
	• materials	
SECTION F(I): **158: Mode of piped water service Membership Payments (Tick as Appropriate)**	**Yes**	**No**
Paid money for membership		
Contributed animal for membership		
Provided labour		
Contributed material		
Other contributions (specify		
If you paid for membership, how much did you pay?	KES ……	
If you contributed animal for membership, what type of animal did you give?	_____	
If you provided labour for membership, what type of labour contribution did you make?	• Own labour	
	• One of my household member went to provide labour	
	• Hired and paid for labour	
If you provided own labour for membership, how many days of labor were given?	_____Days	
If one of the household members provided labour for membership, how many days of labor were given?	_____Days	
If you provided for hired labour for membership, how many days of labor were given?	_____Days	
If you contributed materials for membership, what type of material and how much did you contribute?	----------	
SECTION F(II):Household involvement in Piped Water Committee (governance)		
159: Is there a Committee that manages piped water services?	• Yes	

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	• No	
160: How often does the Committee responsible for managing water services meet?	• Often	
	• Occasionally	
	• Rarely	
161: Is Someone from your household involved in the management of the piped water services?	• YES	
	• NO	
162: Has Someone your household participated in the election of the current piped water committee members?	• YES	
	• NO	
163: Did you or a member of your household attend the piped water service committee meeting in the last three months?	• yes, attended	
	• no, was not invited	
	• no, was invited by did not attend	
	• no, a meeting was not held	
	• Cannot remember	
164: Has anyone in this household ever raised issue regarding the policies of the piped water service?	• Yes, always	
	• Yes, sometimes	
	• No	
	• Don't know	
165: Is there any rules related to the management or use of the piped water service that have been changed in the last one year?	• No	
	• Yes	
	• Don't know	
166: What are the some of the rules that guides the operations of piped water services?	• Change in the amount paid	
	• Change on when the amount is paid	
	• Change in the timing for opening	
	• Others (specify)	

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SECTION F(III): If there is a committee that manages piped water services: 167) How does the committee communicate with the service users(service experience)	**Yes**	**No**
Committee members announce the changes at members' baraza		
Shared through short messages		
Shared through the WhatsApp messages		
Others (specify)		
SECTION F(IV): Payment for piped water services		
168: What are the piped water service payment issues you encounter?		
169: How do you raise the complaints of the piped water service?		
170: When is the piped water service bills sent?		
171: How are the piped water services bill sent?		
172: Is there a deadline on when the piped water services must be paid?	YES	
	NO	
173: What happens to those who do not pay after the deadlines of piped water service payment lapses?		
174: About how many litters of piped water does your household consume during the rainy season?		
175: About how many litters of piped water does your household consume during the rainy season?		
176: About how many much money did you pay for your water bill last month?		

SECTION G: HOUSEHOLD WATER STORAGE PRACTICES	
THE HOUSEHOLD WATER STORAGE PRACTICES	
178: Does your household have water-storage Container for storing – keeping drinking water?	Yes
	No

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179: IF YES, what is the type of the Water Storage container for water for drinking?	_____ _____
180: How do members of the household draw water for drinking from the water storage container?	a) Spigot b) Dip a cup c) Pouring from the container
181: What is the size of the storage container?	_____Ltrs
182: How often do you wash the container for storing drinking water?	_____
183: When was the last time when the container for storing water was used?	_____
184: Did you wash the container for storing water this week?	YES NO

SECTION H: HOUSEHOLDS LIVELIHOOD PRACTICES

LIVELIHOOD PRACTICES	•		
185: Does your Household keep any of the following types of livestock (Goats cows. sheep, and pigs)?	• YES	TICK ONE	
	• NO		
186: IF YES, during the Dry season, does your household use community-managed piped water for watering these animals?	▪ Yes		
	▪ No		
187: Des your household use community managed piped water service for watering the Vegetable / Crops?	▪ Yes		
	▪ No		
188: If YES, which of the crops?	List the crops watered _____ _____ _____		
189: Does your household own Water Storage tank?	▪ Yes		
	▪ No		
190: If YES, What material is the Water Storage Tank made from?	(Tick appropriately) ▪ Plastic		
	▪ Metal		
	▪ Other-describe	_____ _____	
191: If YES, What is the capacity of the storage tank?	_____lts		
192: Is the Tank in good working condition?	▪ Yes		
	▪ No		
193: Does your household collect rooftop rain water	▪ Yes		
	▪ No		
194: If YES, how extensive is the guttering to catch rain?	(Tick appropriately)		

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	a) All around the house b) Half of the house c) A single spout (guttering-pipe) d) Pump from the tank to the house	
195: Is your household residential outside town?	▪ Yes	
	▪ No	
194: During the dry season does your household sell piped water to neighbors for income?	▪ Yes	
	▪ No	

SECTION I: HOUSEHOLD ASSETS

200: **i**s your household connected to Piped water?	• YES	
	• NO	
201: If yes about how much does your household spends paying for the piped water per month?(cost of service)		
202: Are you connected to the electricity grid?	• YES	
	• NO	
203: If yes in a month about how much do you spend paying for electricity?		
204: Which type of toilet do you have/ use?	• Flush toilet	
	• Pit latrine	
	• Open defecation	
	• Other	
205: Which of these essential assets do you own? (TICK ALL THAT APPLY)	• Car	
	• Motorcycle	
	• TukTuk	
	• Tv	
	• Bicycle	
	• wheelbarrow	
	• Radio	
	• Mobile phone	
206: Do you own land?	• Yes	

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	• No	
207: If yes what is the size of the land?		
208: Do you lease land?	• Yes	
	• No	
209: If yes what is the size of the land leased?		
210: What type of Roofing do the households within the homestead have? (multiple answers)?	**Yes**	**No**
1. Grass thatched		
2. Iron roofing (Iron sheets, Dumu sheet)		
3. Asbestos		
4. Concrete		
5. Others (specify)		
211: What type of Walling does the household within the homestead have?	**Yes**	**No**
1. Mud		
2. Bricks		
3. Stones		
4. Cemented wall		
5. Timber		
212: What is your house floor condition?	Earth floor	
	Concrete floor	
	Tiled floor (ceramic, plastic)	
	Wooden floor	

Thank You Very Much for Your

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APPENDIX 2: FOCUS GROUP DISCUSSION INTERVIEW GUIDE

Dear Respondent,

My name is Joel Kinyanjui Njoroge, a PhD student at St Paul's University Limuru Campus (PDSNKR517118). I am currently conducting research for my doctoral thesis titled "Households Factors Associated with Community-managed Water Service Sustained access to service: A Case Study of Nakuru County, Kenya.". The study examines the households' sustained access to service of community-managed water supply and the factors influencing it. I kindly invite you to fill the questionnaire attached to assist me in generating data for my thesis. The study has been approved by NACOSTI and the necessary clearance ethics has been obtained. I kindly request you to answer the questions as sincerely as possible. The information you will give, will only be used for research purposes and your identity will be treated with utmost confidentiality. All data collected will be synthesized into a report.

In case you require further clarification about this study, you may conduct me through Tel: 0719622899 or Email: eleftherios05@gmail.com

Yours truly,



Joel Kinyanjui Njoroge

Consent approval Tick _____

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FGD Discussion Guide - Ngewacho **Community-managed Piped-Water Services**

Women perspectives and experiences with Community-managed Piped-Water Services

Disconnected – NEVER RECONNECTED

Icebreaker

1) How would you describe your HOUSEHOLDS' EXPERIENCE with Ngewacho Community-managed Piped-Water Services?

- ✓ When did your join?
- ✓ What was involved in the joining membership?
- ✓ What was involved in receiving piped water from Ngewacho Community-managed Piped-Water Services from source to your household?

2) DISCONNECTION - When did your household get disconnected?

- ✓ What were the reasons that led to the disconnection of Ngewacho Community-managed Piped-Water Services?
- ✓ For how many months had you been receiving water Ngewacho Community-managed Piped-Water Services
- ✓ Did the Ngewacho Community-managed Piped-Water Services Mgt give you a notice before disconnection?
- ✓ How did the disconnection from the Ngewacho Community-managed Piped-Water Services AFFECT members of your household?

3) Whom would say was most severely affected by the consequences of the disconnection?

- ✓ What does your household get water for drinking, cooking, washing, since the time the Ngewacho Community-managed Piped-Water Services disconnected your households?
- ✓ What are the challenges if any with this alterative water service?
- ✓ Did you or any member of the household engage the management of Ngewacho Community-managed Piped-Water Services affects members of your household to reconnect you to the water service?

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4) Is your household STILL INTERESTED to engage Ngewacho Community-managed Piped-Water Services affect members of your household to reconnect you to the water service?

   - If NO, what are the reasons for the disinterest?
   -
   - How do you perceive the current availability and quality of community-managed piped-water services in your community?

5) Does your household have a rainwater harvesting and storage?
   -If NO, what are the reasons?
6) Does your household plan to install have a rainwater harvesting and storage in the future?
7) -If NO, what are the reasons?
8) Has any member of your household been involved in the committees that govern Ngewacho Community-managed Piped-Water Services?

FGD Discussion Guide - Ngewacho **Community-managed Piped-Water Services**

Disconnected – <u>RECONNECTED</u>

Icebreaker

1) How would you describe your <u>HOUSEHOLDS' EXPERIENCE</u> with Ngewacho Community-managed Piped-Water Services?

✓ When did your join?
✓ What was involved in the joining membership?
✓ What was involved in receiving piped water from Ngewacho Community-managed Piped-Water Services from source to your household?

2) DISCONNECTION - When did your household get disconnected?

✓ What were the reasons that led to the disconnection of Ngewacho Community-managed Piped-Water Services?
✓ For how many months had you been receiving water from Ngewacho Community-managed Piped-Water Services

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- ✓ Did the Ngewacho Community-managed Piped-Water Services Mgt give you a notice before disconnection?
- ✓ How did the disconnection from the Ngewacho Community-managed Piped-Water Services **AFFECT** members of your household?

3) Whom would say was most severely affected by the consequences of the disconnection?

- ✓ Where did your household get water for drinking, cooking, washing, since the time the Ngewacho Community-managed Piped-Water Services during the time when services were disconnected?
- ✓ What are the challenges if any with this alterative water service?
- ✓

4) Who in your household engaged the management of Ngewacho Community-managed Piped-Water Services affect members of your household to reconnect you to the water service?
   - Who paid for the reconnection fee?
   - How long did the Ngewacho Community-managed Piped-Water Services take to effect the reconnection?

5) Who in your household would say has BENEFITTED MOST FROM THE RECONNECTION of Ngewacho Community-managed Piped-Water Services take to effect the reconnection?
6) What other benefits has your household experienced since the time Ngewacho Community-managed Piped-Water Services reconnected your water service?
7) Does your household have a rainwater harvesting and storage?
   -If NO, what are the reasons?
8) Does your household plan to install have a rainwater harvesting and storage in the future?
   -If NO, what are the reasons?
9) Has any member of your household been involved in the committees that govern Ngewacho Community-managed Piped-Water Services?

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FGD - NEVER DISCONNECTED NGEWACHO COMMUNITY-MANAGED PIPED-WATER SERVICES

Icebreaker

1) How would you describe your HOUSEHOLDS' EXPERIENCE with Ngewacho Community-managed Piped-Water Services?

- ✓ When did your join?
- ✓ What was involved in the joining membership?
- ✓ What was involved in receiving piped water from Ngewacho Community-managed Piped-Water Services from source to your household?

2) NEVER experienced DISCONNECTION

- ✓ What has motivated your household to ensure the household is NOT disconnected from the Ngewacho Community-managed Piped-Water Services?
- ✓ For how many months had you been receiving water from Ngewacho Community-managed Piped-Water Services?
- ✓ Is there a time when Ngewacho Community-managed Piped-Water Services Mgt threatened to DOSCONNECT your household from receiving piped water services?
- ✓
- ✓ What did you do to ensure water services were not disconnected?
- ✓ Whom in your household would say would be MOST severely affected if Ngewacho Community-managed Piped-Water Services Mgt disconnected household from receiving piped water services?

3) What are the challenges your household encountered SUSTAINING – MAINTAINING Ngewacho Community-managed Piped-Water Services?

4) Who in your household is responsible for paying for Ngewacho Community-managed Piped-Water Services?

5) Who in your household attends meetings called by Ngewacho Community-managed Piped-Water Services?

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6) Who in your household would say has BENEFITTED MOST FROM THE RECONNECTION of Ngewacho Community-managed Piped-Water Services take to effect the reconnection?

7) What OTHER BENEFITS has your household experienced by sustaining Ngewacho Community-managed Piped-Water Services?

8) Does your household have a rainwater harvesting and storage?
   -If NO, what are the reasons?
9) Does your household plan to install have a rainwater harvesting and storage in the future?
   -If NO, what are the reasons?
10) Has any member of your household been involved in the committees that govern Ngewacho Community-managed Piped-Water Services?

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APPENDIX 3: QUALITATIVE DATA TRANSCRIPT (AMONG ERITHIA HOUSEHOLDS WHO GOT DISCONNECTED AND GOT RECONNECTED)

Women FGD 21 Feb 16.06

Name of transcriber: Joel Kinyanjui

Interviewer: [marked as "I"]

Respondent: [marked as "R"]

Duration: 22 minutes

START OF DISCUSSSION

I: Thank you so much. Let me say hello, how are you?

All: We are well.

I: like I had told you earlier, my name is father Kinyajui, and I came from Gilgil. I am a student of St. Paul's university and this is my professor known as Daniel. We can come here to know all about this water from "Erithia" and after gathering all that information, we will write a book and then return it where it is supposed to be taken so that I can finish my studies. Isn't that good?

All: Yes, it is.

I: I have some few questions for you, at most 9 questions. Will you kindly help me answer?

All: Yes.

I: Thank you. I will ask the first question which will be answered by everyone. Kindly all of you be attentive and prepare to answer them.

All: Okay.

I: Okay. Thank you. I would like to ask, when you had this water, and now that it was disconnected and then reconnected, what are some of the challenges that you or your household face in this water project? Either good or bad. And you are not supposed to fear, we had even told the other group, it is not the project your bad mouthing, you are just giving the water challenges. Have you understood?

All: Yes.

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I: So, where the Chama helps or doesn't do not be afraid mention. Okay.

All: Yes

I: Yes, because some of you may be afraid and even murmur.

All: Laughs.

I: Okay?

All: Yes

I: All that information will be safe.

R1: You see when it is disconnected, one really suffers and when it is there, it really helps. You see water is everything. So when it is disconnected, there nothing you can do.

I: Alright. And can you remember when you joined the water project?

R1: It was many years ago.

I: And to become a member, what was happening?

R1: Okay. One was contributing some money, so that you become a member.

I: Like how much?

R1: One is supposed to pay Kshs 10000

I: Okay. And after contributing Kshs 10000, is there anything else that is required for the water to be installed?

R1: Yes. It is a must you go and dig those ditches.

I: For you, did you dig?

R1: Yes.

I: Alright. How are you?

R2: I am well.

I: I am asking, what are the challenges or benefits your household has seen in this water project?

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R2: Challenges is when it is disconnected, one lacks water and for the benefits, one is able to plant onions, kales and when it is supplied, you are able to water them and have something to eat. You can also sell the kales.

I: Can you remember when you joined this project?

R2: I can't remember.

I: And how did you become a member? Did they ask for something?

R2: Yes. To be a member, I paid Kshs 10000.

I: And after paying the Kshs 10000, was anything else required to ensure that the pipes were installed in your compound?

R2: I just dug canal ditches my compound.

I: Alright. So, you are the one who dug them yourself?

R2: Yes.

I: Thank you so much. Mum, how are you?

R3: I am well.

I: Can you please tell me the advantages or disadvantages of this Erethia water project that your household has seen?

R3: This water from Erethia water project is so good because I am able to do my house chores like to wash clothes, give the cows, goats, and for personal use. They have really helped us.

I: Okay. Can you remember when you joined?

R3: I think it is almost 5yrs since I installed the water.

I: How did you install the water?

R3: One is supposed to write a letter, in order to request you want water so then you are told the requirements and given a list of the required equipment. Then you purchase pipes and taps and dig the ditches. Thereafter, a plumber is then sent to come and install.

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I: So even after paying that amount, there is some other work that is required?

R3: Yes, to dig up the ditches in order to become a member.

I: Okay. Mum, how are you?

R4: I am well

I: This water from Erethia water project, what can you/ your household say about it?

R4: One thing I can say is about cleanliness, you see that the house is clean and everything is in order. And on the other hand, when there is no water, you suffer a lot because even if you go to your neighbour to borrow, you find that they do not have. Sometimes they even refuse to give you the water and yet you can see it like for example if it has been disconnected. You see, now you go around with your wheel barrow to look for it but when the water is available, it becomes easier.

I: Okay. Can you remember the year you joined?

R4: It is about 3yrs.

I: And after joining, how did you become a member?

R4: There is a certain amount of money you pay in order to become a member...

I: Like how much?

R4: The women who are joining now are paying almost Kshs 30000

I: What about you, how much did you pay?

R4: It was almost Kshs 26000.

I: Okay and after paying, is there anything else you were asked to do to ensure the pipes gets to your compound?

R4: You were supposed to buy pipes and to dig ditches at your place. And from there you start paying monthly fees for the water.

I: How much?

R4: For us we pay Kshs 200

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I: Alright. How are you?

R5: I am okay

I: I will ask you the same question. How can you describe the water from Erethia water project?

R5: For me, I can see its goodness because even after hustling, I know that if I go back home, I will find water. I will just take one drum, fetch water from outside and take it to the house. Cleanliness is number one because the water is available. If it is any work that involves water, I will not go to borrow from my neighbour. If let's say there's no water, you find sometimes that they don't give you because they will say you haven't paid your water. So I always see that if you have water, it is like you have life.

I: Okay. Can you remember when you joined?

R5: I joined in 2007.

I: And how did you become a member?

R5: I first drafted a letter for the office. After giving them, that is then when they replied. I pleaded and that is when they replied and I became a member.

I: Is there something you were required to pay to become a member?

R5: I paid Kshs 10000.

I: And after paying, you asked to do something else so that they can install the pipes?

R5: Now after that, because where the main pipes are, they are on the main road. So to direct the water to your compound, you were required to dig ditches and then purchase your own pipes, have them installed so that the water can get to your house.

I: Okay. Thank you so much. Mum, how are you?

R6: I am okay.

I: This water from Erethia, what can you say about it?

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R6: I can say that that water is good. It really helps us in farming, giving water to cows and to plant kales and onions things like that. The challenges come in when they disconnect the water. You see you even lack drinking water.

I: Okay.

R6: Yes. So that makes us suffer because of lack of water.

I: Alright. And when did you join this project?

R6: 2004.

I: And what were the requirements of becoming a member?

R6: Then I paid Kshs 8000.

I: And after paying the Kshs 8000, did they ask for anything else so that they can install the pipes?

R6: Nothing else. You just had to buy pipes so that the water can be supplied at your place. Now those are the ones I bought and also digging the ditches.

I: Okay so you are the one who dug them.

R6: Yes. I am the one

I: Mum, how are you?

R7: I am well.

I: This project, how do you know about it? What can your household say about this project?

R7: I can say in this Erethia water project; it has really helped me since I installed that water because you cannot struggle while at home. If you want to farm, you won't struggle, you'll just water your kales which in turns makes you not to go to the market to buy kales and onions. So, I have seen its goodness.

I: Can you remember the year you joined?

R7: It is almost 10 to 11 years now.

I: Alright. And what was asked for you to become a member?

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R7: I just registered myself that I want water and they then accepted.

I: Alright. And were you asked for anything in order to be a member?

R7: Yes. I was asked to pay Kshs 10000

I: Okay and after paying were you asked to do something else to ensure that the water reaches your place?

R7: Yes. You were required to buy pipes, dig ditches and something of the sort.

I: Okay. Thank you so much. Mum, how are you?

R8: I am well.

I: In your household, what can it say concerning this water project?

R8: This water from Erithia helps us wash clothes, give drinking water to the cows and to plant kales or even onions.

I: And when did you join the project?

R8: Like 10yrs ago.

I: What was happening in order to become a member?

R8: Once is required to draft a letter, and when they accept, you are required to pay a certain amount of money and then you dig your ditches...

I: But for you, you paid?

R8: Yes, I did.

I: And then you cater for?

R8: digging the ditches, buying the pipes and paying the plumbers.

I: Okay. Thank you so much. Mum, how are you?

R9: I am okay.

I: This water from Erethia, what can your household say about it?

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R9: My household has really benefited, because before I installed, I installed it in 2010, I was really struggling but for now I have seen its goodness.

I: Is there anything you did to become a member?

R9: Yes. I paid Kshs 10000

I: Okay. And after paying membership fee, is there anything else you were required to do?

R9: I was required to pay labour fees.

I: For labour, what did you purchase?

R9: Pipes and taps and now paying the plumbers.

I: Okay. Thank you so much. Mum, how are you?

R10: I am very well.

I: What can you say about this water?

R10: I can say that the water has really helped me because since I installed it, I have been able to farm our crops like those kales, I don't get them from the market. So, the water has really helped us and also in my home's cleanliness.

I: Alright. Can you remember in which year you joined this project?

R10: It was around 2006

I: Okay and how did you join in order to become a member?

R10: I just drafted a letter, I gave it to them and I was accepted. The water was then installed.

I: Okay. Thank you so much. Is there anything else you were asked to do?

R10: There are some things I was asked to do because there is something you are required to pay in order to become a member and have that water installed. I paid around Kshs 10000.

I: And after paying the water was supplied in your house?

R10: Yes. I also bought pipes so that the water can reach my home.

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I: Okay. The money that you paid, how did you get it? Is it maybe by borrowing, Chama, your husband you know people have different sources of getting money.

All: Laughs

R10: Let me say, I came together with my husband to raise the money. We even sold a goat inured to get money and buy the required equipment like those pipes.

I: Okay. For you, the pipes were installed, where did you get the money?

R1: It is my husband who catered for everything.

I: All of it from the beginning?

R1: Yes. Up to labour.

I: Okay. Thank you so much. What about you? Where did the money come from?

R2: I contributed with my husband.

I: For you, where did you get the money?

R2: I sold my chicken. (Laughs)

I: Okay. Thank you. (Laughs)

ALL: (Laugh)

I: What about you? Where did you get the money?

R3: I took a loan from my Chama group and sold a goat.

I: Alright. Thank you. Mum, I know that maybe then was a long time ago...laughs

All: Laughs.

I: Can you remember where the money came from?

R4: Yes. I borrowed from my Sacco.

I: Okay. Mum can you remember?

R5: Yes, I can. My daughter was working as a florist and that is where she took a loan to pay.

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I: Can you remember where the money came from?

R6: We had planted maize, which we sold and later installed the water.

I: Okay.

R7: My husband took a loan from work in order to install the water.

I: Okay, what about you?

R8: We sold milk and later on sold a pig.

I: Okay

R9: We sold a goat.

I: We are asking, the whole process of digging the ditches, from the main road to your compound, who facilitated?

R1: Okay. We had two employees but we also dug.

I: So, you paid them?

R1: Yes.

I: Alright. In your household who dug the ditches?

R2: My husband.

I: Alone?

R2: Yes

I: What of installation?

R2: We looked for a plumber.

I: Okay. Thank you. Who dug the ditches in your household?

R3: My husband came together with his friends. They volunteered to help him instead of having to pay someone else. I in turn cooked for them. They really helped us.

I: Alright. So, for you, you cooked for the "Jeshi"

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All: Laughs

R3: Yes.

I: what about you?

R4: We dug them with my husband.

I: Just the two of you?

R4: Yes.

I: What about you, who facilitated?

R5: My daughter came with them and she paid them.

I: What about you mum? Who dug the ditches?

R6: My children.

I: Boys or girls?

R6: Boys

All: Laughs.

I: Okay. Who dug your ditches?

R7: I paid young men to do it.

I: What about you? How were they dug?

R8: It was my husband and my 2 shamba boys.

I: The ones you have employed?

R8: Yes.

I: Yours? Who dug them?

R9: My husband and I

I: Just the two of you?

R9: Yes.

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I: Yourself you were digging?

ALL: (Laugh)

R9: Yes.

I: Okay. What about you, who dug the ditches?

R10: I employed people. Some men.

I: Did you dig yourself?

R10: No, I didn't, it was just the young men.

I: Okay. Thank you so much. Is there anyone of you who had a challenge of where the pipes would pass because the neighbours wouldn't allow? The neighbour is maybe not allowing the water to get to your compound.

R: Yes, they are there.

I; Did you encounter such?

R: Yes, you find that your neighbour doesn't want the pipes to pass in his/her compound and that is where it is supposed to pass.

I: Okay. So, there was a misunderstanding?

R: Yes.

I: How did you finally solve?

R: The ditches we dug in my compound.

I: Alright. Anyone else? Okay. Who here can say that her pipes were destroyed by maybe cars, tractors anyone?

R: Yes. When the road was being constructed, we go through such cases because maybe the tractors passed through where the pipes are and it destroys it. This forces you to call a plumber to come and fix them. This makes one to go back to the pocket and buy another pipe so that the water can be supplied.

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I: Alright. Anyone else? Maybe it got destroyed by the children while digging, the tractor, cars, is there anyone? Alright. When the water was disconnected, can you remember when it was disconnected?

R1: It was long ago, it was around 2008

I: Now, why was it disconnected?

R1: Lack of paying the water bill.

I: And when it was disconnected, who was most affected?

R1: I as the mother since I am the one who uses a lot of water. Before even my husband is aware that there is no water, I am the one who suffers.

I: Okay. Can you remember when yours was disconnected?

R2: 2023.

I: What was the cause of the disconnection?

R2: I had not paid the water bill

I: And after that, who was most affected in your household?

R2: Myself because, I am the one who uses a lot of water...

I: What about you mum, can you remember when your water was disconnected?

R3: It was this year.

All: Laughs.

I: This same year, (laughs)

ALL: (Continue laughing)

I: Okay who was the most affected?

R3: I am the one who suffered the most because I am the one who was drawing water from the river.

I: And can you remember the reason for that disconnection?

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R3: Not paying the water bill. I did have money, is it not like I refused to pay. Laughs

All: Laughs

I: Okay I understand. What about you, can you remember when your water was disconnected?

R4: Yes. It was last year.

I: And what was the reason for the disconnection?

R4: Not being able to pay the water bill.

END OF DISCUSSION

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APPENDIX 4: QUALITATIVE DATA TRANSCRIPT; ON NGEWACHO HOUSEHOLDS WHO NEVER GOT DISCONNECTED

Women FGD_21_Feb_12.08

Name of transcriber: Joel kinyanjui

Interviewer: [marked as "I"]

Respondent: [marked as "R"]

Duration: 25 minutes

START OF DISCUSSION

I: Thank you. I would like to ask you some few questions - 10 questions only, but we will do this interview quickly. Allow me say hello again, how are you?

All: We are okay.

I: You are a beneficiary of this water from Ngewacho?

R1: Yes.

I: What are the problems that you or your household have faced while using this water from Ngewachu?

R1: The problem that I have faced is that, when the water is unavailable, I get the issue of not having water to use but when this water from Ngewachu came, it became easier for me because my life got easier and I got time to do some other chores because I am able to take water.

I: Okay. Can you remember when you got the water? Which year?

R1: I can't remember the year I joined, but it has been almost 7years since I started using it.

I: Okay. How was one joining? Or how was one becoming a member?

R1: When I joined, I was told to pay Kshs 700 so that I can join. So, when I paid, they d that the water cannot still get to us, they then advised us to top up Kshs 300 and after paying, when the water was supposed to be supplied, they said that the amount is still not enough. I was then told to add Kshs 200 and that when the water was supplied. So, in total I paid Kshs 1200.

I: Alright. So that you can also become a member?

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R1: Yes. So that I can become a member of the water initiative.

I: After becoming a member, what was used so that the pipes can get to your place?

R1: What was used is, we were given something small by the MP then we topped up so that we can get the water.

I: Is there anything else you were doing in order for the water to be supplied at your home?

R1: There is nothing else I was doing, maybe just buying pipes to supply water inside my house.

I: Okay. Thank you so much. I will ask you the same question I asked R1. What are the problems you have faced in the Ngewacho water?

R2: There is a time where there is no water at all since, they supply it only one day in a week, so when one is in need of using the water, it becomes difficult. So, there are times when we don't have water.

I: Okay and when did you join?

R2: It has been about 6yrs now.

I: You can't remember the exact year?

R2: No, I can't very well.

I: Okay. This water, to become a member what was the process?

R2: In order for one to be a member, I remember we were told to pay Kshs 1000 and then we carry our hoes to go dig the well.

I: And for the pipes to get to your house, what did you do? Or what exactly happened?

R2: For that, we were contributing a little amount of money and also, we were supported.

I: Okay. What of the pipes to get to your house? Were you digging yourselves or what happened?

R2: We were doing that ourselves.

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I: Thank you so much. I will ask you the same questions. I will ask, with this water, what are the issues you've faced, either good or bad?

R3: I would say that this water is okay because it helps us especially like us the young parents. It helps in washing the baby clothes and some other house chores but there are some challenges we face. The water is only supplied once a week and you may find that when the water is being supplied, you may find you didn't get time to fetch the water.

I: When did you start using the water? Can you remember the year?

R3: No. I can't remember but it is almost 6yrs since I started using it.

I: Alright. How would one acquire membership?

R3: We were registered. We were asked to pay Kshs 1000 each then when it came to supplying water to your specific house, I remember for us, we came together as neighbors to dig the ground so that the pipes could be installed. And also, the MP assisted so we didn't use a lot of money.

I: So, after becoming a member, there is nothing else you were doing to ensure the pipes gets to your place?

R3: It was just buying the pipes and digging up the canal ditch for water pipes and that is where we came together as neighbors.

I: Okay. Thank you so much. I will also you the same questions. What are the issues you've faced in this water initiative for Ngewachu?

R4: The challenges I have faced is the water being supplied once a week and you have a lot of things to do with it. One may have cows, and they require water so you find that the water isn't enough. The time that they supply water is also less and you get enough time to fetch the water. So you find that you have a lot of things that require water but it becomes difficult and the water isn't enough for the household.

I: Okay. When did you join? Can you remember the year?

R4: I cannot remember the year, but it has been almost 9yrs.

I: What was happening in order to become a member?

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R4: To become a member, I paid Kshs 1200 and to offer labor in order to become a beneficiary of the water.

I: what of the pipes to get to your house? Is there anything else that was required?

R4: Nothing else was required, just buying your own pipes so that the water can get to your house.

I: So, it was dug up to your gate?

R4: I offered labor so that the canal ditch could be dug.

I: Okay. Thank you so much. I will also ask you the same questions. What are the challenges your household has faced regarding this water?

R5: This water has really us, but some of the challenges I have faced is that we are given a few hours to fetch and also the water is supplied at a low pressure which may not reach where you want to store. So, when it gets the time to turn off the water, you find that it has not reached where you wanted to store it because of the low pressure.

I: Can you remember when you joined?

R5: I can't remember the year but the joined when the project started.

I: The year when the water project began?

R5: Yes.

I: How was one becoming a member?

R5: We were paying some money. We paid Kshs 700 when we started.

I: And once you become a member, so that the water can get to your house, what was required?

R5: After becoming a member, where the main point for the water is, I installed my pipes and the ones that I had bought, I was told that they were too thin. I was then forced to dig them up and purchase the thick ones.

I: Okay. Thank you so much. I will also ask you the same questions, what are the challenges you've faced in this Ngewacho water project?

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R6: Let me say in this, in this Ngewacho water project, when the water is supplied, it comes when it is sunny and doesn't come in the rainy season. Now since this water is supplied using solar, we have a challenge when it is cloudy. When it is cloudy, we usually don't have water.

I: When did you join the project?

R6: I think it was 2015.

I: Okay, and what did you do to become a member?

R6: To become a member, there was registration in order to join the rest. We were contributing Kshs 1200.

I: Okay. After becoming a member, for the pipes to get to your house, is there something that was happening?

R6: There is something that was happening, because there is a time, we were digging the main canal ditches which are in the main road. To get inside my compound, it is I who facilitated.

I: Alright. What of the main ones?

R6: Main it is still us who were digging but the ones to get to your compound, you do it as an individual.

I: Okay. Thank you so much. How are you?

R7: I am well.

I: I will also ask you the same questions I asked R6. What are some of the Issues, either good or bad that you have faced in the Ngewachu water project?

R7: I would say that I have seen the goodness in it since the water helps me in my household activities, if it is cows and goats and even house chores but some of the challenges are, the water did come up to our homestead. Now you see even when it is being supplied, you'll just fetch a little bit and then it runs out!

I: Yes. When did you join?

R7: I joined when it started, that is when I registered but since I figured that it won't get my place, I joined officially last year, 2024. That is when I started using it.

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I: Alright. And what was happening in order to become a member?

R7: We were registering with Kshs 1200.

I: And is there anything else you were doing so that the water could reach your place?

R7: Yes, we were digging the ditches so that the pipes could be installed.

I: Alright. Thank you so much. How are you?

R8: I am okay.

I: Okay. I will ask you the same questions I have asked the person beside you...

R8: Okay.

I: This water from Ngewacho project, what are the challenges that your household has faced while using the water?

R8: With this water in my household, I am usually happy because this water really helps us and it came to relief us since we used to fetch water far away. But when it came, it really relieved us since the fetch water from our compound. But some of the challenges that are there is that maybe when the water is being supplied, maybe you will not be around and when you get home you may find that it has been turned off.

I: Okay. Thank you. Can you remember the year you joined?

R8: I cannot remember but I think it is around 8yrs now.

I: Okay. What was happening in order to become a member?

R8: To become a member, I paid Kshs 1200.

I: After being a member, there is that journey of making sure the water gets to your place?

R8: Yes

I: What was happening?

R8: In order to supply water to my house, we came together as neighbors - a few of them, we then involved our children who helped us dig up the ditches and then we contributed some money to buy the pipes since we saw that the main pipes had already been catered for. So we

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used that togetherness to ensure that the water gets to our homesteads. We bought the pipes and installed them ourselves.

I: Okay. Thank you so much. How are you?

R9: I am well.

I: Has the water from the Ngewachu project reached your home?

R9: Yes, it has.

I: What are some of the challenges you have faced?

R9: Let me say that is good because it has helped me. It has relieved my journey of going to look for water. The water easily available and I am able to feed my cows, chicken and anything else that I have. I am now able to do my own farm duties without any difficulties. So, it really helps me.

I: Alright. When did you join?

R9: Let me say that I did join when it started, I joined in 2016.

I: Alright. And what did you do to join?

R9: I went and registered with Kshs 2000. We later formed a group where we dug the ditches and bought the pipes. That is when the water was supplied in our homesteads.

I: Okay. Thank you so much. How are you?

R10: I am well.

I: I will ask you the same questions, this Ngewachu water, has it reached your homestead?

R10: Yes.

I: What are some of the challenges you face?

R10: Let me say that it is supplied only once week and sometimes it doesn't reach our homestead but it is good because I am able to do my stuff. Also, it helps me because you know we used to fetch water from the river? Now when they reached the compound, it helps us a lot because we are able to do our chores.

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I: When did you join?

R10: I cannot say when I joined, but it is almost 3yrs because where the stay, I found the water there.

I: Okay. How did you become a member?

R10: I cannot say because where I live, I just rent.

I: Okay. Thank you so much. How are you?

R11: I am okay.

I: I will ask you the same questions. What are some of the challenges you've faced?

R11: It is so good because it relieved me the duty of going to fetch water from the river. But there are times where one is not around and you will not be able to fetch that water.

I: when did you join?

R11: When it started because even when the main ditches were being dug, I was there. It is around 7yrs now.

I: what was happening in order to become a member?

R11: For me, one had to be involved in the process of digging up the main ditches. I also Paid Kshs 1000 to become a member. In order for the water to get to your household, we used to come together.

I: Okay. Thank you so much. How are you?

R12: I am very well.

I: I am asking this question, what are the challenges your household has faced during this Ngewachu water project?

R12: Okay I have really benefited. The moment the water got to my house it helped but when you are not around and it is being supplied, you may not be helped.

I: Alright. Can you remember when you joined?

R12: Okay. I think when I joined it was 2018 until now.

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I: Okay. What was happening for you to become a member?

R12: We were asked to pay Kshs 1200, we come together as a group you then dig up your own ditches so that the water can reach your place.

I: what else was required for the water to reach your place?

R12: Another thing we were doing is that one was asked to purchase pipes so that the water can reach your place.

I: Alright. Thank you so much. I appreciate. How are you?

R13: I am very well.

I: Can you tell me either one or two challenges you have faced in this Ngewachu water project.

R13: I know of its goodness since we drink it. It has really helped us because we don't do to the river. I only see its goodness.

I: Okay. When did you join?

R13: I cannot remember when I joined.

I: Okay. And how did you join or how did you become a member?

R13: When the project started, let say I didn't join but there are times when I used to dig the ditches and then I stopped. But after some time, I decided to join and I paid Kshs 1200.

I: Okay. Thank you so much. How are you?

R14: I am well.

I: Is the Ngewachu water at your place?

R14: Yes, it is.

I: Okay what are some of the challenges you've faced.

R14: The water has really helped me because since I joined, I don't have many difficulties. Nowadays I don't take my cows to the river or I don't fetch water with jerricans to feed them. They take water whenever they want. So, I have seen its goodness.

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I: Which year did you join?

R14: I cannot remember the exact year, but it was when it started. A few of us were meeting under a tree where we used to think about this water so that it can reach us.

I: And to become a member what was happening?

R14: We started with Kshs 1000 those of us who joined among the first.

I: In order for the water to reach your homestead, is there something that was happening or is there something that was requested?

R14: Yes. There is something we were doing, we used to dig up ditches for the main pipes and impeded for the water to reach your homestead one had to buy his/her own pipes.

I: Okay. Thank you so much I appreciate. Another question, you have all told me that you used to dig up the ditches yourselves, what are some of the challenges you faced while doing so?

R: They used to measure where each person is supposed to dig and there are places that had a lot of stones which could even take up to 2 days to dig.

I: Okay. Thank you so much, anyone else?

R: We used to dig up the ditches you could find maybe some big roots and it would take a lot of time. One was required to use other means to cut the roots since one couldn't use a panga.

I: What were you using alternatively?

R11: We were forced to look for something else which could cut, at an expense something like a power saw.

I: Power saw. Thank you.

R: The process of digging up the ditches had a lot of challenges because there is a time, if it becomes difficult to dig; you're forced to hire someone to help you.

I: You hire someone to come and dig it for you?

R: Yes.

I: Okay. Thank you

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R: Okay that process of digging was so difficult especially for me since I was not feeling well and one had to dig his/her portion. That time because I was sick, I was forced to hire someone to help me. Also, another thing, the equipment being used, one may not have them and so you're then forced to borrow.

I: Okay

R: Let me say it was difficult. Like for me, I had a small baby and I was forced to hire someone. Some neighbors offered to help since one had to dig his/her portion. So, I hired someone sometimes and other times the neighbors could help.

I: People from your village?

R: Yes. My neighbors.

I: They dug your ditch.

R: Yes, so that it can be done.

I: Okay. Thank you so much.

R: I would say it was difficult since I was about to have a baby. But since I didn't have money to hire someone, I even almost gave birth there but some women helped me.

I: Okay. Thank you.

R: Okay for me, it was so difficult. I was trying to dig it, sometimes try to hire someone because the measurements per person were 10 steps. I canal also had to be deep and because I don't have that strength, I used to hire someone.

I: Okay. Anyone else.

R: Let me say it was a difficult situation. Let's say you have been given a very difficult portion to dig, even if you beg the person to change it, they didn't. You may not even have enough money to pay someone to do it for you, so one used to take a lot of time in one portion because you could even find many stones there and you are required to dig a certain depth.

I: Okay. Thank you

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R: Okay. For me I didn't face any challenges since I didn't join the project then. I just joined when the water was there. That is why I paid Kshs 2000 since I didn't dig the canal ditches.

I: Alright. Thank you so much.

I2: Did anyone of them have a neighbor where he/she refused the pipes to pass through.

I: I hope you've heard that question...

R: Like around our place, there is a neighbor who said that he doesn't want the ditches at his place. After even digging, he said we should cover it and dig outside his compound.

I: After even installing the pipes.

R: Yes, after installing the pipes. That we should dig outside and install the pipes there.

I: Okay any other person who had the same neighbour? No one else?

R: Okay. Let me say that it was at the road where we were hindered. Like for example, after digging the ditches with my neighbour, in order to pass the pipes, we were warned and even issued a letter to stop it and if we don't, we will be fined Kshs 200,000.

I: Okay. Another question I am being asked is, is there any one of you who have had her pipes burst, maybe intentionally by someone?

R: Yes. If someone is unable to pay for the water, it is turned off. When they do so, some people get angry and if your neighbors, they come and burst it so that you cannot also benefit.

I: Okay. Anyone else?

END OF DISCUSSION

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APPENDIX 5: **QUALITATIVE DATA TRANSCRIPT ON NGEWACHO HOUSEHOLDS WHO HAD THEIR WATER DISCONNECTED AND NEVER RECONNECTED**

Women FGD_21_Feb_11.30

Name of transcriber: Joel Kinyanjui

Interviewer: [marked as "I"]

Respondent: [marked as "R"]

Duration: 24 minutes

START OF DISCUSSION

I: I would like to ask you a few questions. You are the ones who had their water cut. You had the water and then it was disconnected? Is it true?

All: Yes

I: So that I don't interview the group that is wrong. Now according to you, what are some of the challenges you face during the Ngewacho water project?

R1: I was not able to wash clothes, I got super tired and my spine also got damaged due to carrying water since I was going to fetch water very far away and when I got sick, I used a lot of money to pay people to fetch it for me and my children used to be dirty

I: Alright and when did you join this project?

R1: 2019

I: Okay and was happening in order to be a member?

R1: We were to digging canal ditches so many meters and also we were told to contribute some money.

I: For what?

R1: To purchase maybe pipes and all.

I: Okay. To become a member what was required?

R1: I have said, I was volunteering to dig the ditches and also money to buy pipes.

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I: Okay. Thank you so much. How are you?

R2: I am well.

I: According to you, what are the challenges that you or your household have faced in this Ngewachu water project?

R2: It is to lack water and maybe you want to use it to for example, bath your children, washing your clothes and utensils and do all chores in general and there is no water.

I: Alright. When did you join this project?

R2: 2019

I: How was one becoming a member?

R2: To be a member, one had to volunteer him/her self to dig the ditches and buy pipes

I: Is there anything else you were doing to be a member?

R2: it was just digging the ditches and also registering. There is some amount of money that was required.

I: Like how much?

R2: Like Kshs 200 or Kshs 300 there about.

I: Okay and once you became a member, what was happening in order to get the pipes?

R3: For the pipes, one had to dig the ditches so that the water can get to your homestead.

I: Okay. Thank you. How are you?

R4: I am well

I: According to you, what are the challenges that you or your household were facing or are facing in this Ngewachu water project, now because yours have been reconnected?

R4: This water really helps us because we are able to feed our cows and also you cannot stay in a house that does not have water. You are also supposed to wash your clothes and when you don't have water, it becomes difficult.

I: Alright. When did you join this project?

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R4: I joined in 2019.

I: Okay, and to become a member, was there something that was being requested in order to become a member of the water?

R4: There was a lot of things required, sometimes we were told to go dig the ditches and also there was some money required in order to be a member.

I: How much?

R4: It was a lot of money because they even asked for Kshs 2000.

I: Alright. Thank you so much. And for the pipes to get to your homestead, what was happening?

R4: You go back there and dig ditches so that the pipes can get to your home.

I: Alright. Thank you so much. How are you?

R5: I am well

I: Now, according to you, what are some of the challenges your household face in this water from Ngewachu?

R5: We have faced a lot of challenges because since I came here, I have experienced alot of difficulties because of water. Because I had a small sick baby, and it was a nose problem because of dust and lack of money and I used to go very far to fetch water.

I: Okay. And since it was installed, what are the challenges you have faced?

R5: I have seen a lot of changes, since we are to was clothes and bath and also feed the cows.

I: Alright. When did you join this project?

R5: 2018

I: What was required in order to be a member?

R5: once I become a member., now because I did not take part in the digging process, I was asked to pay a lot of money in order to become a member.

I: After becoming a member, to have pipes in your homestead, what was happening?

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R5: I was told to dig ditches from the main road and also purchase those pipes.

I: Alright. Thank you so much. How are you?

R6: I am well.

I: Since you joined this project, what are the challenges you have faced?

R6: This water really helps me, but when it was disconnected, I really suffered because looking for water is a lot of work. My back really hurts due to carrying jerricans. But since it was reconnected, I have seen its goodness because even if they are my goats I will be able to feed them, even if it is clothes, I will be able to wash them now because looking for water is where the issue is.

I: Okay. In which year did you join this project?

R6: When the project started. I used to dig the ditches; it was a lot of work. I was even assisted, but I always thank God because we now have water and May God bless the one who remembered us and I was even asking, if there is a way to even help the widows due to the problems we are facing (laughs).

I: Laughs, alright. And to become a member, are there things that were requested?

R6: Yes. We were paying some money so that those who are yet to get the water, they benefit.

I: Okay. How much were you contributing?

R6: We were contributing Kshs 300 so that even those who are yet to get water they benefit.

I: Okay. Thank you so much.

R6: Thank you.

I: Thank you. Allow me to ask you another question. When was the water disconnected or in which year did, they disconnect the water?

R1: It was 2020.

I: And who in your household was the most affected?

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R1: I myself because I had just given birth to my twins and I had a lot of work because of washing clothes for those children.

I: Alright

R1: Yes, and I required a lot of water.

I: Alright. Thank you so much. In which year was your water disconnected?

R2: 2020

I: And who was most affected by this?

R2: I, because I have a salon and now you see we will require water.

I: Yes. Alright. Thank you so much. When was your water disconnected?

R3: 2020

I: Who was most affected?

R3: Myself because I am a widow and I are the one who goes through all the problems of supporting the household.

I: Okay. Thank you so much. In which year was your water disconnected if you can remember?

R4: 2022

I: Alright, and who was most affected in your household?

R4: Myself.

I: Okay in what way?

R4: Washing the clothes, you have small children and one is required to have a lot of water to wash those clothes.

I: Alright. Thank you so much. We are now back to you; can you remember when your water was disconnected?

R5: I really cannot remember.

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I: You can't remember when it was disconnected?

R5: Yes, now because I am so forgetful.

I: Alright. And when it was disconnected, who was most affected?

R5: I, now because I am the one who will be forced to fetch the water which becomes very difficult because of my health.

I: Okay. After it was disconnected, what were you doing to get the water?

R1: I was going to a river which is very far away and when I got back pains, I started to pay someone to fetch it for me.

I: Okay. And the problem to fetch that water was which one or what were the problems you were facing when fetching water from the river?

R1: I developed a back problem and sometimes children wearing dirty clothes it even brought forth domestic violence, maybe your husband wants to bathe, there is no water as well as children and it made things super unpleasant.

I: Okay. Thank you so much. Where were you fetching your water after the disconnection of Ngewachu water?

R2: We were footing up to Gakirikiri and when you are unable to walk, you request for a motorcycle to bring the water.

I: And when it was disconnected, the problem of going to fetch the water was like or even that of hiring a motorcycle?

R2: The issue was cleanliness, maybe you want to wash your utensils, maybe your husband wants to bathe and the children want to bathe in order to go to school and all.

I: Okay. So, the issue is that the water...

R2: Is not readily available.

I: Alright. Thank you so much. When your water was disconnected, where did you get the water?

R3: I used to go to a place called chamuka which is so many Kilometers away.

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I: Like how many?

R3: Like 2kms.

I: alright. And the issue of that water is which one?

R3: The issue is a lot because let's say you don't have money; you are forced to hustle in order to afford like that motorcycle to bring the water.

I: Okay. Thank you so much. When your water was disconnected, what was your source?

R4: I was going to Gakirikiri, a river known as Gakirikiri that is where I was going.

I: Alright. And the problem of fetching that water is which?

R4: It was difficult; you see now you have to hustle to hire that motorcycle. One was even forced to go at night to fetch that water.

I: Alright. Thank you so much. We are now back to you, we are asking, when the water was disconnected, what was your source for drinking water?

R5: When it was disconnected, it was facing a lot of problems. I sometimes even slept hungry because I had no one to fetch it for me. When I am lucky and have some money, I used to look for a motorcycle to go and fetch it for me. So, I used to wait until when God could provide me with money that is when I used to send someone.

I: And the challenge of fetching that water as compared to the piped one is which?

R5: You see for the piped one, you can even fetch it with a bottle as for the other one, you are supposed to use a jerrican and even carrying it becomes a problem. Now when it is readily available, I can even use a bottle to even fetch water for cooking but before then it was super difficult.

I: Okay. Thank you so much. Now we are back to you again. We are asking, who paid the water in order for it to be reconnected?

R1: Let me say I took a loan because I was not going to work; I was taking care of my children. So, some place I used to take my milk, I took a loan of Kshs 5000.

I: So, it was you who paid?

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R1: Yes, I am the one who paid. I took Kshs 3000 and paid the water. I just had to sacrifice myself.

I: Alright. The committee took how long to come and reconnect the water?

R1: No, they did reconnect it immediately in fact I really struggled, I pleaded a lot with them up to a point of almost asking for a bribe for them to reconnect.

I: (Laughs) Alright.

R1: Yes. For them to come and reconnect.

All: Laughs

I: Okay. Thank you so much. And what are the benefits you have seen after the reconnection of the water?

R1: It helps in drinking water for the cows and I have a small farm that has kales and the water helps in watering them.

I: Okay. Thank you so much. Who paid the water for it to be reconnected?

R2: I am the one who paid. I took a loan from a women's Chama to pay the water to be reconnected.

I: OK, and after paying, how long did it take for them to reconnect?

R2: They really took a lot of time because one used to go there and they tell you to wait. I actually waited patiently until I got tired.

I: Alright. But finally, they reconnected?

R2: Yes. They finally reconnected.

I: After reconnection, what are the benefits you have seen?

R2: I am able to wash my customers when they come to the salon and keep the salon clean.

I: Alright. What of at home, any benefits?

R2: Yes. I am able to water my crops like kales and onions.

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I: Alright. Thank you so much. We are back to you, who paid the water for it to be reconnected?

R3: Myself because I looked for a job and then it was reconnected.

I: And, how long did they to reconnect?

R3: It took a while.

I: Alright. And since it was reconnected, have you seen its benefits?

R3: That water has really been helpful since I don't get tired like I used to and I again I give it to my cows and also farm.

I: Alright. What do you usually farm with it?

R3: I farm cabbages, kales etc.

I: Okay. We are back here, who paid for the water to be reconnected?

R4: Myself by hustling here and there.

I: After paying, how long did It take for them to reconnect?

R4: It took a while because you used to them you have enough money for them to reconnect but they really took their time.

I: Alright, and after the reconnection, what are the benefits?

R4: A huge one because I am able to wash clothes, bathes the kids and wash utensil all that. Cows even have enough drinking water.

I: alright. Thank you so much. Who paid for the water to be reconnected?

R5: I took a loan; I have actually not paid it fully since I cannot work but I have seen its goodness. Because I could even sleep hungry due of lack of water even if you have ingredients. But I have seen its goodness, I give it to my cows, I am able to drink and even wash my clothes.

I: Alright.

R5: For me I don't farm since I do not have the strength to go to the farm.

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I: Alright. How long did it take for them to reconnect?

R5: They took a lot of time; it is a must you have something small to pay.

I: Okay. Back to you. In you homestead, do you have somewhere where you harvest water?

R1: Yes. I have bought a small tank.

I: Like how many liters?

R1: Like 2000 Liters and that is where I store my water.

I: Alright. Is it placed on the iron sheets?

R1: When it rains, the water is harvested and when the Ngewacho water comes, I still store it there.

I: Okay. And in your household is anyone in the committee of leading this water project?

R1: No.

I: Okay. In you homestead do you harvest rain water?

R2: Yes. I have a 250 Liters tank.

I: So, you don't have a big tank?

R2: No. I only use that and jerricans.

I: Alright and do you have any plans of purchasing?

R2: Yes.

I: In your household, has anyone even been in the water committee?

R2: No.

I: Okay. Thank you so much. Do you have a tank for harvesting water?

R3: Yes, I do.

I: Like how many liters?

R3: 3000 litres.

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I: And is there anyone in your household that is in the water committee?

R3: No

I: Okay. Thank you so much. Do you have somewhere you harvest water?

R4: No.

I: You don't have?

R4: Yes. I just have water drums and jerrycans.

I: Alright and will you buy a water tank in the near future?

R4: Yes

I: Okay. Is anyone in your household a water committee leader?

R4: No.

I: Okay. We are here again mum.

R5: Yes

I: We are asking, in your homestead, do you have somewhere you store water?

R5: I have a small tank

I: How many litres?

R5: I think it is around 10 litres, the one I use to fetch watch at home.

I: The Skyplast?

R5: Yes.

I: And do you have any plans of buying a tank?

R5: I always say that when God gives me money, I can buy a tank and so that when it rains, I am able to harvest some water to help me even if this other water is supplied.

I: Alright, in your household has there been a water leader?

R5: No.

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I: Alright. Thank you, thank you. Okay we are back here with the last question. Which is, do you have a women's Chama that you attend?

R1: Yes, I do

I: Alright. Do they have the capacity of lending you money to get a bigger tank?

R1: No. But it is still new. So, we are not yet capable.

I: Okay. Do you have a table banking group?

R2: Yes, I do.

I: Can they maybe help you to borrow money from them you go build a tank?

R2: No. We have not reached that point since we started not long ago.

I: Alright. Thank you so much. Do you have a women's Chama sister?

R3: Yes.

I: Is it enough to lend you money to go and purchase or build a good tank.

R3: No, because we are not even many.

I: Alright good. Thank you so much. Do you have a Chama that you attend?

R4: Yes.

I: Is it capable of lending you money to buy/build a tank?

R4: No.

I: Why

R4: We are not so many.

I: Alright. Thank you. Mum, do you have a women's Chama that you attend?

R5: Yes.

I: Is that Chama capable of lending you money to build a tank?

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R5: No, we are still a new group. For now, we can't. We just borrow like Kshs 1000 or Kshs 2000

We are still not yet capable.

I: Okay. Thank you so much.

Supervisor: I would like to appreciate you all for your time, for setting aside all your house duties to come for this interview as this man is studying his PhD. He will also come back to say thank you. I would just want to say thank you so much.

All: You are welcome

I: Okay. Thank you so much.

END OF DISCUSSION

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

APPENDIX 6: INTRODUCTION LETTER FROM ST PAUL'S UNIVERSITY

ST. PAUL'S UNIVERSITY

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18th May, 2022

National Commission for Science and Technology,
P.O. BOX 30623-00100,
Nairobi.

Dear Sir/Madam,

RE: RECOMMENDATION FOR JOEL KINYANJUI NJOROGE- PDSNKR517118
TO CONDUCT RESEARCH

This letter confirms the above named person is a student of the Doctor of Philosophy in Development Studies Program at St. Paul's University.

The second year consists of a major research work leading to a dissertation. The student's selected topic is *" Implications of Models of Community-Managed Water Supply on Households' Sustainability of Benefits of Water Service: A Case Study of Nakuru County, Kenya."*

Kindly grant this student the required permit.

Yours Faithfully,

DIRECTOR POSTGRADUATE STUDIES ST. PAUL'S UNIVERSITY 18 MAY 2022 P.O. BOX PRIVATE BAG - 00217, LIMURU

Dr. Julius Kahuthia
Director, Board of Postgraduate Studies

ST.PA

APPENDIX 7: APPROVAL NACOSTI

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **647309**

Date of Issue: **02/March/2023**

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This is to Certify that Rev.. joel kinyanjui njoroge of St. Paul's University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Nakuru on the topic: Implications of models of community-managed water supply on household sustainability of benefits of water services:case of Nakuru county Kenya for the period ending : 02/March/2024.

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