St. Paul's University Repository

INFLUENCE OF HOUSEHOLD WATER USE CHARACTERISTICS, TECHNICAL AND GOVERNANCE FACTORS ON FINANCIAL SUSTAINABILITY OF COMMUNITY-MANAGED BOREHOLE WATER KIOSK SERVICE IN KISUMU COUNTY, KENYA

JACKTONE OMULLO AKELO

PDSLMR 416420

ST. PAUL'S UNIVERSITY

A PHD THESIS PRESENTED TO THE SCHOOL OF EDUCATION AND SOCIAL SCIENCES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF DEGREE OF DOCTOR OF PHILOSOPHY (PHD) IN DEVELOPMENT STUDIES OF ST. PAUL'S UNIVERSITY

NOVEMBER 2023

St. Paul's University Repository

INFLUENCE OF HOUSEHOLD WATER USE CHARACTERISTICS, TECHNICAL AND GOVERNANCE FACTORS ON FINANCIAL SUSTAINABILITY OF COMMUNITY-MANAGED BOREHOLE WATER KIOSK SERVICE IN KISUMU COUNTY, KENYA

JACKTONE OMULLO AKELO

PDSLMR 416420

SUPERVISED BY:

DR. DANIEL MUASYA NZENGYA, PHD

&

DR. SARA J. MARKS, PHD

A PHD THESIS PRESENTED TO THE SCHOOL OF EDUCATION AND SOCIAL SCIENCES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF DEGREE OF DOCTOR OF PHILOSOPHY (PHD) IN DEVELOPMENT STUDIES OF ST. PAUL'S UNIVERSITY

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

DECLARATION

This Thesis is a product of my own work. It is not a product of anything done in collaboration and it has not been previously presented to any institution. I agree this Thesis may be available for reference and photocopying, at the discretion of St. Paul's University.

Signature of the Candidate: ---------- Date…06.10.2023----------

Jacktone Omullo Akelo – PDSLMR 416420

Word Count: 53,484

Approval by Supervisor

We confirm that the work reported in this Thesis has been done by the student under our supervision

~~NAMES OF SUPERVISORS:~~

Signature:---------- Date: ----------

Dr. Daniel Muasya Nzengya, PhD

Faculty of Social Sciences

St. Paul's University, Limuru

And

Signature: --  --- Date:----------

Dr. Sara J. Marks, PhD

Water Supply and Treatment,

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

Swiss Federal Institute of Aquatic Science and Technology
(EAWAG), Switzerland

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

ABSTRACT

Access to safe drinking water is a global challenge, with approximately one-quarter of the world's population lacking such access. Kenya, like many Sub-Saharan African countries grapples with water insecurity, leading to the establishment of water kiosks as a solution. However, these kiosks often face financial sustainability challenges. This study examined the influence of user household characteristics, technical designs, and governance factors on the financial sustainability of community-managed borehole water kiosk services in Kisumu County, Kenya. The specific objectives were six-fold. First, to analyze the influence of water kiosk user household characteristics. Second, to assess the influence of user households' sense of ownership. Third, to analyze the influence of water kiosks' technical design and layout. Fourth, to examine the influence of borehole water committee governance. Fifth, to assess the influence of the user household participation in governance. Finally, to examine the significance of land ownership in moderating the influence of the user household characteristics, technical designing and governance factors on the financial sustainability of community-managed water kiosk services. A mixed-method research design was employed, combining qualitative data from three focus group discussions with 31 water kiosk operators and quantitative data from questionnaires administered to 460 user households. Descriptive statistics and binary logistic regression were used to analyze quantitative data, while thematic analysis was used to analyze qualitative data. In the first objective, the study findings revealed that user satisfaction had statistically significantly influence on financial sustainability (odds ratio = 3.36; p = .01) of community-managed borehole water kiosk services. Other statistical significance was revealed for time taken to fetch water (odds ratio = 3.52; p = .001); and household seasonal use of the water from the water kiosks (odds ratio = 11.20; p = .001). For the second objective, study findings revealed that payment for membership to the borehole water kiosk (odds ratio = 3.64; p = .001); and users' perception of ownership of the water kiosk for the people living within the village (odds ratio = 0.41; p = .001) were revealed to be statistically significant in influencing financial sustainability of community-managed borehole water kiosk services. For the third objective, it was revealed that borehole kiosks that opened twice in a day (odds ratio = 3.58; p = .050) had statistical significance while water kiosk discharging water with moderate pressure (odds ratio = 0.64; p = .070) had statistically marginal significant influence of financial sustainability. Furthermore, in the fourth objective, knowledge of the water committee members (odds ratio = 0.54; p = .002) and the frequency of water committee members meeting (odds ratio = 0.02; p = .026) were also established to be statistically significant in influencing financial sustainability of community-managed water kiosk. For the fifth objective, the household contributions towards the establishment of the borehole water kiosk (odds ratio = 0.01; p = .001) was revealed to significantly influencing financial sustainability. Finally, for the sixth objective, the findings revealed that the ownership of the land on which the borehole was located (odds ratio = 3.70; p = .002) was statistically significant in influencing the financial sustainability of community-managed borehole water kiosk services. Results from qualitative analysis triangulated these findings from statistical analysis. For instance, during the focus group discussions, the kiosk operators were equally concerned about the seasonal patterns in fetching water from the borehole water kiosks. Therefore, efficient service delivery, water quality maintenance and responsiveness to seasonal variations are essential for financial sustainability. Membership fees play a crucial role in financial support, while the complexity of ownership beliefs suggests the need for tailored engagement strategies. Finally, land tenure issues should be addressed to enhance kiosk sustainability. Policy-makers and stakeholders should consider these findings to develop strategies that ensure reliable access to safe drinking water in Kenya and similar regions.

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

DEDICATION

This PhD Thesis is dedicated to my family (Caroline, Clement and Esther) and my late parents (Jennifer and Shem).

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

ACKNOWLEDGEMENTS

My utmost gratitude goes to God Almighty for Strength and Grace throughout this Epoch of my life. It's a dream dating back to 1997. To Him my Creator & Saviour Jesus Christ is all the Glory.

I am grateful to Dr. Daniel Muasya and Dr. Sara Marks for all the insights, encouragement and guidance in writing of the proposal, data collection, analysis and thesis writing and corrections. Your insights at every stage were very valuable and treasured in my life. I appreciate every stage. I appreciate the financial support accorded by EAWAG & ETH4D that went a long way in the preparatory, data collection, analysis and thesis writing as well as three-month fellowship in Switzerland.

I appreciate the teams that worked with me at the EAWAG, ETH4D, St. Paul's University, Graduate Hub, Doctoral Association of East Africa and University of Pittsburgh. I may not list all your names, because you are many and your support, cheering and encouragement were as many as you are. I appreciate you for the contributions of shaping my thoughts, guiding my journey and toiling with me. I cannot forget my 2020 classmates. You are all special.

My special appreciation goes to my wife Caroline, son Clement and daughter Esther, who have had to put up with absent Dad who minimized family participation and contributions.

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

CONTENTS

DECLARATION....iii
ABSTRACT....iv
DEDICATION....v
ACKNOWLEDGEMENTS....vi
LIST OF FIGURES....xi
LIST OF TABLES....xii
ACRONYMS AND ABBREVIATIONS....xiv
CHAPTER ONE....1
INTRODUCTION AND BACKGROUND....1
1.1 Chapter Introduction....1
1.2Background to the Study....1
1.2.1Provision and Status of Safe Water Services....1
1.2.2 Legal and Policy Frameworks Governing Community Water Supply....5
1.3Statement of the Problem....14
1.4 Research Objectives....15
1.4.1 General Objective of the Study....15
1.4.2 Specific Objectives of the Study....16
1.5 Research Questions....16
1.6 Justification of the Study....17
1.7 Scope of the Study....18
1.8 Limitations of the Study....19
1.9 Study Assumptions....19
1.10 Operational Definitions of Key Terms....20
1.11 Organization of the Study Document....21
1.12 Chapter Summary....22
CHAPTER TWO....23
LITERATURE REVIEW....23
2.1 Chapter Introduction....23
2.2 Theoretical Review of the Study....23
2.2.1 Common-Pool Resource Theory....23

ST. PAUL'S UNIVERSITY

2.2.2Socio-Technology Theory.....25
2.3 Sustainability in Community Water Supply.....27
2.4 Rural Water Supply and User Household Participation.....30
2.5 Technology in Community Water Kiosk Networks and Supplies.....31
2.6 Community-Managed Borehole Water Governance System.....34
2.7 Empirical Studies Reviews.....38
2.7.1 Empirical Review of Water Kiosk Piped Network Designs.....39
2.7.2 Empirical Review of Governance Community-Managed Water Kiosks.....41
2.7.3 Empirical Review of Beneficiary Characteristic of Water Kiosks.....42
2.7.4 Empirical Review of Sustainability Community-Managed Water Service.....44
2.8 Summary of Reviewed Gaps for the Study.....46
2.8.1Empirical Research Gaps in Community Water Service Provision.....47
2.8.2Categorization of Research Gaps.....50
2.9 Conceptual Framework in the Factors of Sustainability of Water Kiosk Services.....53
2.9.1 Conceptual Framework.....53
2.9.2Operationalization of the Conceptual Framework.....53
2.10 Chapter Summary.....55
CHAPTER THREE.....56
RESEARCH METHODOLOGY.....56
3.1 Chapter Introduction.....56
3.2 Philosophical Foundation Informing the Research Design.....56
3.2 Research Design.....58
3.3 The Study Area.....59
3.4 Overview of Water Coverage in Target Study Site.....60
3.5 Implications of Demographic Changes and Implication of Water Service.....60
3.6 Community-Based Water Organizations.....61
3.6.1 Water Management Models in Kisumu County.....61
3.6.2 Selection of Boreholes for the Study.....62
3.7 Target population.....65
3.8 Sampling, Sample Size and Sampling Frame.....65
3.9 Data Collection and Analysis.....66
3.9.1 Quantitative Data Collection and Analysis.....66

ST. PAUL'S UNIVERSITY

3.9.2 Operationalization and Measurement of Study Variables....67
3.9.3 Computing Household Socio-Economic Status....68
3.9.4 Descriptive Statistical Analysis and Quantitative Data....69
3.9.5 Description of Logistic Regression....69
3.9.5 Reliability and Validity....71
3.9.6 Qualitative Data Collection and Analysis Methods....73
3.9.7 Ethical Issues and Approvals....75
3.8 Chapter Summary....76
CHAPTER FOUR....78
STUDY RESULTS AND INTERPRETATIONS....78
4.1 Chapter Introduction....78
4.2 Demographic Information of Respondents....78
4.3 Households Fetching of Water for Domestic Use....79
4.4 Year of Establishment of Boreholes and Water Kiosks....80
4.5Influence of User Households' Characteristics on Financial Sustainability....82
4.5.1 Households Main Sources of Water for Domestic Use and Drinking....82
4.5.2 Household Seasonal Use of Borehole Water Kiosk Services....83
4.5.4 Association of Household Water Use Characteristics with Financial Sustainability....85
4.5.4 Influence of Household Water Use Characteristics on Financial Sustainability....88
4.6 Influence of User Household Sense of Ownership on Financial Sustainability....90
4.6.1 Household Sense of Water Kiosks and Association with Financial Sustainability....91
4.6.2Influence of Households Sense of Ownership on Financial Sustainability....93
4.7 Influence of Technical Factors on Financial Sustainability of Borehole Water Kiosks....94
4.7.1Descriptive Results on the Technical Designs of Borehole Water Kiosks....94
4.7.2 Association of Technical Factors on Financial Sustainability....95
4.7.3 Influence of Technical Factors on Financial Sustainability....98
4.7.4 Other Technical Factors on Financial Sustainability....100
4.8 Influence of Household Perception on Water Committee and Sustainability....101
4.8.1 User Household Perceptions on Borehole Water Committee Functions....102
4.8.2 Association of Water Kiosk Governance with Financial Sustainability....103
4.8.3 Influence of Water Kiosk Governance on Financial Sustainability....105
4.8.4 Other Water Kiosk Governance Issues for Financial Sustainability....106

ST. PAUL'S UNIVERSITY

4.9 Influence of User Households' Participation in Financial Sustainability....107
4.9.1 User Household Participation in Community-Managed Water Kiosk Governance....107
4.9.2 Association of Users Participation in Governance with Financial Sustainability....108
4.9.2 Influence of Users Participation in Governance with Financial Sustainability....110
4.9.3 Other Results of Users Participation in Governance with Financial Sustainability....112
4.10 Influence of Land Ownership on Financial Sustainability....112
4.10.1 Land Ownership of Financial Sustainability of Water Kiosks....113
4.10.2 Association of Land Ownership with Financial Sustainability of Water Kiosks....115
4.10.3 Influence of Land Ownership with Financial Sustainability of Water Kiosks....117
4.11 Chapter Summary....118
CHAPTER FIVE....120
DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS....120
5.1 Chapter Introduction....120
5.2 Discussions of Study Results....120
5.2.1 Socio-Demographic Characteristics and Financial Sustainability of Kiosk Services....120
5.2.2 User Households' Characteristics and Financial Sustainability....122
5.2.3 User Households' Sense of Ownership and Financial Sustainability....123
5.2.4 Water Kiosk Technical Designs and Financial Sustainability....124
5.2.5 Water Kiosk Governance, Participation and Financial Sustainability....124
5.2.6 Water Kiosk Land Ownership and Financial Sustainability....125
5.3 Conclusions of the Study....126
5.4 Contribution of the Study to Knowledge....128
5.5 Study Recommendations....129
5.5.1 Recommendations for Policy....129
5.5.2Recommendations for Future Research....130
REFERENCES....131
APPENDICES....148

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

LIST OF FIGURES

Figure 1.1: Schematic Design of the Structures in Water Act 2002.....10

Figure 3.2: Borehole Study Sites.....62

Figure 4.3: Year of Water Kiosk Establishment.....81

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

LIST OF TABLES

Table 1.1: Regulatory for Water Service Provision....13
Table 2.1: Grounding the Theories with Research Objectives....26
Table 2.2: Selected Research Gaps for Community Water Service Provision....48
Table 2.3: Linking Study Objectives with Variables....53
Table 3.1: Selected Community-Managed Boreholes for Study....58
Table 3.2: Sampled Site Population Dynamics....60
Table 4.1: Basic Socio-Demographic Characteristics....70
Table 4.2: Household Drinking Water Practices....72
Table 4.3: User Households Description of Years of Boreholes and Kiosks Establishments....73
Table 4.4: Household Borehole Water Kiosk Use Patterns....74
Table 4.5: Household Borehole Water Kiosk Seasonal Use Patterns....75
Table 4.6: Seasonal Water Use Reasons and Frequencies....77
Table 4.7: Cross-tabulation of User Characteristics and Financial Sustainability....78
Table 4.8: Binary Logistic Regress Model Analysis....80
Table 4.9: Household Sense of Ownership of Borehole Water Kiosk....82
Table 4.10: Cross Tabulation of User Sense of Ownership and Financial Sustainability....83
Table 4.11: Influence of Sense of Ownership on Financial Sustainability....84
Table 4.12: Technical Designs and Layout of Borehole and Water Kiosks....86
Table 4.13: Association of Technical Factors and Financial Sustainability....87
Table 4.14: Influence of Technical Factors and Financial Sustainability....90
Table 4.15: User Household Perception on Water Committee Governance....93
Table 4.16: Association of Water Committee Governance with Financial Sustainability....94
Table 4.17: Influence of Water Committee Governance on Financial Sustainability....95
Table 4.18: Household Participation in Borehole and Water Kiosks Governance....98
Table 4.19: Association of User Households Involvement in Kiosk Management....98

ST. PAUL'S UNIVERSITY

Table 4.20: Influence of Users Participation in Governance in Financial Sustainability.....100
Table 4.21: Moderating Factors Influencing Sustainability of Borehole and Water Kiosks.....103
Table 4.22: Association of Moderating Variables and Financial Sustainability.....104
Table 4.23: Influence of Moderating Factors on Financial Sustainability.....107

ST. PAUL'S UNIVERSITY

APPENDICES

APPENDICES 1: TOOLS USED FOR DATA COLLECTION

Appendix 1.1a: Operators' Focus Group Discussion Consent Form....148
Appendix 1.1b: Operators' Focus Group Discussion Guide....149
Appendix 1.2a: Household Survey Questionnaire Consent Form....151
Appendix 1.2b: Household Survey Questionnaire....153
Appendix 1.3a: Key Informant Interview Consent Form....162
Appendix 1.3b: Key Informant Interview Check-list....163
APPENDICES 2: ETHICAL AND APPROVAL DCUMENTS....164
Appendix 2.1: Letter of Admission to PhD Candidacy....164
Appendix 2.2: Letter of Introduction to NACOSTI....164
Appendix 2.3: NACOSTI Research Permit....165
Appendix 2.4: Letter from Water Department, County Government of Kisumu....168
Appendix 2.5: Ethical Board Approval by DURB....169

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

ACRONYMS AND ABBREVIATIONS

AGM	Annual General Meting
BH	Borehole
BOM	Boards of Management
CAR	Central Africa Republic
CBWS	Community-Managed Water System
CAAC	Catchment Area Advisory Committee
CFC	Chlorofluorocarbon
CoK	Constitution of Kenya
CM	Community-Managed
CIDP	County Integrated Development Plan
CGK	County Government of Kisumu
HPB	Hand Pumps Boreholes
IWP	Institutional water point
JMP	Joint Monitoring Programme
KEBs	Kenya Bureau of Statistics
KIWASCO	Kisumu Water and Sewerage Company
LMI	Low and Middle income
O&M	Operations and Maintenance
MDG	Millennium Development Goal
NGO	Non-governmental Organization
NWCPC	National Water Conservation and Pipeline Corporation
NWP	National Water policy
SDG	Sustainable Development Goal
SEM	Structural Equation Modelling
SSA	Sub-Saharan Africa
USD	United States Dollar
UN	United Nations
UNICEF	United Nations International Children and Education Fund
WHO	World Health Organization
WB	World Bank
WP	Water point
WRMA	Water Resources Management Authority
WSRB	Water Services Regulatory Boards
WRUA	Water Resources Users Associations
WSB	Water Service Boards
WSTF	Water Services Trust Fund
WT	Water Tribunal
WUA	Water Users Associations

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

CHAPTER ONE

INTRODUCTION AND BACKGROUND

1.1 Chapter Introduction

This chapter foregrounds the background to the problem of this study. It explores the issue of water security in Sub-Saharan Africa, an issue rife with various challenges. It therefore places this study within a geographical, social and political context. Additionally, it provides the historical and legal framework of community water service provision at the global, national and local levels as well as policy framework and previous actions taken in order to make water service provision sustainable. The other prominent areas in the chapter are the statement of the research problem, the specific research objectives, the hypotheses, the research questions, the justification of the study, the scope of the study and the inquiry's limitations and assumptions.

1.2 Background to the Study

1.2.1 Provision and Status of Safe Water Services

Continued access to safe water supply remains an important issue in water resources management and development (Egbinola, 2017). The United Nations (UN) Sustainable Development Goals considers availability and sustainable management of water and sanitation for all as the sixth Sustainable Development Goal (SDG6), and this has been shown as related to seven (7) other SDGs (Blanc, 2015). More specifically, Target 6.1 provides for achieving universal and equitable access to safe and affordable drinking water for all. The Target 6b calls for support and strengthening of participation of local communities in improving water and sanitation management (Ortigara et al., 2018). The SDG6 targets 6.1 and 6b appreciates Five (5) aspects of access to water, including universality (accessible to all), equitability (proportionately accessible in the rightful manner), safety (within the water quality standards), affordability (within the pricing which is economically feasible in the said community) (Ojha et al., 2018), and participation of local communities. The Constitution of Kenya-2010 provides that "every person has the right to clean and safe water" (CoK, 2010: 43 (1d)), while Kenya's Vision 2030's

ST. PAUL'S UNIVERSITY

goal is "to increase both access to safe water and sanitation in both rural and urban areas beyond present levels." These Global and National level policy documents acknowledge and commit to the importance of the water resources and related services as a basic need and the desire for its optimal management.

However, safe drinking water, while abundant in some countries, remains a scarce communal resource in most regions worldwide (Contzen & Marks, 2018). The UN WHO and UNICEF estimated one in any four people lacked safely managed drinking water in their homes in 2020. Furthermore 19% representing 1.6 billion people were unable to access safely managed drinking water (WHO/UNICEF JMP, 2021). At least eight of 10 of the 1.6 billion people facing in access to safely managed drinking water live in the rural areas. The WHO/UNICEF-JMP defined safely managed water as drinking water from an improved source which is located on premises available when needed - free from faecal and priority chemical contamination (Organization, 2017). It further defined the basic level as the drinking water from an improved source and provided the collection time to be less than 30 minutes for a round trip, including queuing. The third level was the limited, which is drinking water from an improved source for which the collection time exceeds 30 minutes for a round trip, including queuing. The remaining two lower levels of the ladder, according to JMP, were unimproved (drinking water from an unprotected source) and surface water (drinking directly from open surface water).

ST. PAUL'S UNIVERSITY

Improved water source is one that, by nature of its construction or through active intervention, is protected from outside contamination, in particular faecal matter contamination (Gomez et al., 2019; Pearson et al., 2016). Other authors described improved drinking water sources to include piped water into households or compounds, public tap or standpipe, tube well or borehole. On the other hand, improved water encompassed a cart with small tank or surface water (Barnes et al., 2018; Marks, 2012), protected dug well, protected spring, and or a rain water point (Marks, 2012). Though there exists numerous improved drinking water sources, it is estimated that over a quarter of the Global population still depends on unsafe drinking water supplies impacted by faecal contamination (WHO, 2017). Furthermore, an estimated 2.2 billion people do not have access to safely managed drinking water (Ovink et al., 2023). Such persons probably use water

from unprotected or open surface sources. Around 829,000 people succumb annually to diseases directly attributed to unsafe water, inadequate sanitation and poor hygiene (Khalifa & Bidaisee, 2018; Prüss-Ustün et al., 2014).

Countries in sub-Saharan Africa have particularly low levels of access to safe drinking water. Adopting the JMP Ladders, established in 2017, the WHO and World Bank estimated the percentages of access to basic drinking water services in Africa. In their estimation, those at the top were Egypt and Libya (99%), Tunisia (96%,) Algeria (94%), South Africa (93%) and Botswana (90%). Those with the lowest access were Chad (39%), South Sudan and Ethiopia (at 41% each), Democratic Republic of Congo (43%), Central Africa Republic (46%); and Burkina Faso and Uganda (at 49% each). These estimates were taken using the proportion of the country's 2017 population data. The basic drinking water services in their case was defined as drinking water available when needed, free from contamination, and a round trip to collect water taking less than 30 minutes. Kenya, representing regional trends, was estimated in the WHO/WB study at 59% but it has improved to 63% (WHO/UNICEF JMP, 2023). It was also established that about 70% of population residing in rural areas, has only about half of rural households identifying an improved water point as their main drinking source (Wyche & Olson, 2018; WHO, 2015).

In a number of cases, these inadequacies in safe water facilities were socially and politically induced challenges, defined by the established water governance. The concept of water governance refers to the range of political, social, economic and administrative systems that are in place to develop and manage water resources (Zentai & Gronemeier, 2022). These are expected to deliver water services to different levels of society (Rogers & Hall, 2003). In other words, water governance has been defined as the system of actors, resources, mechanisms and processes, which mediate society's access to water (Cleaver & Franks, 2007). Governments, communities and development agencies have heftily invested in water projects. However, many such projects either failed or lacked the sustainability component (Kilonzo & George, 2017). Providing water security is a key dimension of poverty reduction in developing countries. Despite the political efforts, and economic, social and financial investments, existing data

ST. PAUL'S UNIVERSITY

indicates moderate progress to date, and huge inequalities appear when comparing access to water within rural or urban areas, and trends within different regions. While in most developed countries the provision of safe, regular and adequate water services (Pearson et al., 2016) is in the purview of the national and devolved governments, it is sometimes not the same in the developing countries. In many developing countries, water service provision in the rural areas is left to community management structures, while the national and devolved state actors seek to provide for the urban and peri-urban residents. The community-managed supplies adopt a hybrid of arrangements, sometimes guided by the source of funding from the system. In some instances, the funding institution may provide a greater chunk of the initial construction investment, with or without community contributions, while such a community may agree to cover related post-construction expenses.

Though the millennium development goal on water was achieved ahead of schedule, globally, an estimated 2.2 billion people remained without access to improved drinking water within a reasonable distance from home (Khalifa & Bidaisee, 2018). According to (Kelly et al., 2017) approximately one-third of boreholes in rural sub-Saharan Africa fail within five years of construction. Observable causes of the failure can be categorized into either technical, governance or both. Some of the technical causes include the design of the water systems and pipelines, connections and metering of the water yields, water quality and treatment as well as unaccounted for water from the leakages. Some of the issues of governance may include siting of boreholes, kiosks or other watering collection points land tenure and ownership, policies and procedures of collection, use and accounting of revenues from the water service points, establishing and functioning of the water committees, operation and servicing of water systems.

Kelly et al. (2017) observed that interruptions in water service may compel users to revert to alternative, potentially unprotected sources. As a result, modelled data suggests that these may undermine any health benefits provided by the water systems. Such source switching, though not always, may also be driven by seasonal factors (Contzen & Marks, 2018). Previous research studies on factors associated with water system functionality in rural areas have focused on water systems with hand-pumps since these were the primary means of providing rural water supply by

ST. PAUL'S UNIVERSITY

most enabling actors. However, other types of water extraction technologies exist, including motorized pumps such as fuel, electricity or solar-powered mechanized systems (Nyakwaka & Benard, 2019; Kelly et al., 2017). The rates of access to domestic water services in rural sub-Saharan Africa (SSA) are among the lowest worldwide (Marks et al., 2013). One reason for the slow rate of progress is that installed water infrastructure regularly fails before the end of its design life. Currently, the rural water systems in developing countries have proven to be more difficult to keep functional than constructing and often, the systems prematurely breakdown due to technical design and governance related issues.

In Tanzania, a study established 46% non-functional public improved water points in rural areas (Taylor, 2009), while in Kenya and Ethiopia, it was estimated that a third of the existing water points were broken down. Localized to Kenya's Siaya County, of the 80 water projects constructed by various development agencies in the past 20 years, 90% were non-functional by the year 2006 (Oraro, 2012). Preliminary mapping of water points by Kisumu County Water Office, as of October 2020 and whose report was not published, estimated a failure rate of between 24% and 40% of the points managed by Water User Association committees. In Nyando Sub-county of the Kisumu County, UNICEF rehabilitated more than 100 failed water points in 2009, and further developed additional sources. However, common factors in such failed projects were identified as ownership and, or management issues by communities (Nyakwaka & Benard, 2019). Locally, to Kenya's Kisumu County, community-managed water points have mixed revenue contributions and non-fees; upfront flat figure payments or pay-as-you-fetch methods. Such decision processes are taken by the water service management committees or relevant institutions managing the water points.

ST. PAUL'S UNIVERSITY

1.2.2 Legal and Policy Frameworks Governing Community Water Supply

1.2.2.1 Global Community Water Framework

With its establishment and acceptance, perspectives have risen on sustainability as observed by Phillips & Pittman (2014). One such perspective is the Global environmentalism that focuses on

the depletion, pollution, species and habitat loss and climate change. The second other perspective is the technological optimism (limits-to-growth viewpoint), which holds that human ingenuity and technology will be able to conquer environmental problems. Unfortunately, this does not happen in many of the problems raised earlier. Some have actually incorporated environmental factors in the economic models, while others have questioned the fundamental level and desirability of the endless economic growth on a planet with finite resources. In this regard, some have advocated for a "steady-state society" with qualitative rather than quantitative economic growth, while others have advocated for new forms of capitalism that better incorporate environmental and social concerns. The third perspective of social advocates have argued that global inequalities where countries with low global population consumes almost a quarter of the world's resources. The final perspective is that of the spiritual and ethical observers who argue that the crises facing humanity are as a result of misplaced values. In summary, these perspectives are held by economists, environmentalists, equity and environmental activists.

Absence of a sound regulatory system and a strong regulator are generally held as constraints to good performance by the public as well as private sector operators. In either of the cases, the regulator should have a clearly defined mandate and authority, with an independent source of funding. The primary responsibility of the regulator should be to supervise operators, both public and private. Two types of regulations are necessary; that is, quality regulation and economic regulation. Quality regulation is used to track the quality and delivery of service providers. It entails monitoring service operators to determine whether they are meeting their contractual obligations to provide access to the service coverage and quality within the authorized tariffs rather than merely providing access to dysfunctional infrastructure. To do so effectively, the regulator should define goals and performance standards so that actual service delivery can be compared with them. In addition, the regulator should define the tariff policy, provide information on required investment to meet stated goals, and advise on funding sources to meet the investment goals. The minimum standards to be followed are to be defined by central government, leaving regional governments to define local standards, provided they are not lower than the national standards. Best practice suggests that both public and private sector service

ST. PAUL'S UNIVERSITY

providers should operate under the specified targets, with regards for exceeding such targets and sanctions for failure to meet them in terms of costs and timeliness. Quality regulation is needed to monitor the implementation of reform measures and the flow of resources into the sector.

Competition between the operators and benchmarking are considered to be powerful instruments of economic regulation (Lannier & Porcher, 2014). Competition helps improve performance and/or reduce costs, hence reducing the charges and improving affordability. Benchmarking yields information that can be used for performance comparison and tariff setting (McDonald, 2016). Its outputs can give signals, which can help to determine whether programs are on track to achieve the targets. The information it provides can give signals that can be used for making mid-course adjustments to technical strategies in order to improve sector performance. In view of the importance of such information, central governments should provide incentives to local governments and operators for good reporting.

1.2.2.2 History and Policy Framework of Community Water Services in Kenya

The legal framework for water service provision in Kenya draws back to several years. There is a detailed historical institutional and legal framework, adopted by this study, dating back to 1974 (Butterworth & Juma, 2005). The 1974 institutional arrangement of water sector began with development of the National Water Master Plan. The plan had two objectives. One objective was to ensure availability of water, at reasonable distance, to all households, by the year 2000. The second objective required the Government to directly provide water service to consumers in addition to its role of policy making, regulating use of water resources, and sector financing activities as provided for in the Water Act, Chapter 372. Both objectives were noble pursuits by 'New' African governments following independence, including Kenya. However, the second one was contradictory, as the Government acted as the referee (policy setting) but also as the player (service provider). The implementation of the plan saw the upgrade of the Department of Water (DPWP) at Ministry of Agriculture to Ministry of Water. By the year 2000, the Ministry of Water had developed immensely and was managing 73 piped urban water systems serving 1.4 million people and 555 rural water systems serving 4.7 million people.

ST. PAUL'S UNIVERSITY

In 1988, the Government of Kenya established the National Water Conservation and Pipeline Corporation (NWCPC) (Kamuti, 2013). The purpose for NWCPC was to take over management of government-operated water supply systems in 21 urban centres serving 2.3 million people and 14 large water supply systems serving up to 1.5 million people across rural communities. However, 2.3 million other people were served by systems operated by self-help (community) groups with funding from donor organizations and technical support from District water officers. Large municipalities were licensed to supply water within their areas. By 2000, Ten municipalities supplied 3.9 million urban dwellers. Persons not served under any of the above arrangements did not have a systematic water supply service. They had to make do with such supplies, as they were able to provide for themselves. Alternatively, they directly collected water from open water source or some other sources on a daily basis.

While setting up of NWCPC was a noble goal, by 2000, less than half the rural population had access to potable water. In urban areas, only two-thirds of the population had access to potable and reliable water supplies. Furthermore, by 2020, the access to safe water was estimated to average only 59% (safely managed, basic and limited UN ladders). As well, the initial Master Plan's aim was only concerned about the access of water at a reasonable distance. In the same 2000 assessment, it was identified that the quality of water accessible to be less than half of the rural population. In 1980s, the Government's budgetary constraints led to its failure to deliver the promised water service, thus leading to the "handing over". Though there was a general agreement over the need to hand over Government water supply systems, there was less agreement over what it meant for the Government to hand over public water supply systems to others.

In 1997, the Ministry of Land Reclamation, Regional and Water Development published a manual giving guidelines on handing over of rural water supply systems to communities. The manual indicated transfer of management of water supply schemes stressing those communities would act as custodians of the water supply schemes (asset); take responsibility for operating and maintaining the systems; with the aim of community management being in ownership of the

ST. PAUL'S UNIVERSITY

water supplies and associated assets. The criteria for the community to take over included the ability to pay, the capacity to operate and maintain the system, involvement of women in management and the ability and willingness to form community-based groups with legal status.

In 2002, ten schemes serving 85,000 people had been handed over under these guidelines. However, these hand-overs focused on management and revenue collection, and not full transfer of the assets. While there had been approaches to sensitize for women inclusion and participation in community development activities, not many communities had embraced that concept. In addition to that, two criteria on the capacity to operate and legal status of the community-based institutions were not properly articulated. These capacities were developed and took time to get implemented, while Ministry officials themselves did not have the technical capacity to develop the same skills within the said communities. The resultant outcomes were that many of these systems were either not handed over, handed over in haste, or those handed over failed to remain functional.

In summary, the Manual had both positive and negative attributes. First, the acknowledgement that the success of the systems depended on ownership by the communities was a great policy commitment by the Government. It was an acknowledgement by the Government bureaucrats, though reluctantly, that the communities had something to offer in the management of their water service provision. Second, the capacity to operate and maintain a system is one that needs to be built. However, the manual did not categorically outline the responsibilities or how communities would gain such capacity. If anything, the Government officers were themselves not prepared with the requisite skills to build that capacity. Furthermore, the handing over process was a result of the constraints in fiscal budgets; hence the Government could not allocate any further funding towards building such capacity, to its officers or the communities. Third, in a majorly patriarchal Kenyan rural society, the involvement of women in management was ideally a long requirement, which needed time to strengthen mainstreaming of gender issues.

Based on these experiences, the Government developed a fully-fledged policy: The National Water Policy (NWP), adopted by Parliament as Water Sessional Paper of 1999 (Government of

ST. PAUL'S UNIVERSITY

Kenya, 1999). First, the Government's role was redefined away from direct service provision to regulatory function. Second, the service provision was to be left to the Municipalities, the private sectors and the communities. Third, the Water Act, Chapter 372 was reviewed and updated, with attention to transfer of facilities. Thus, the Policy justified handing over as the ownership of the water facility encourages proper operations and maintenance (O&M); and encouraged that the facilities should be handed over to those responsible for their O&M. The Policy stated that the Government would hand over urban water systems to autonomous departments within local authorities and the rural water supplies to communities.

While developing the NWP, the Government also established a National Task Force that reviewed the Water Act, Chapter 372 and developed a Draft Bill to replace the Water Act. The Water Bill was published, passed by Parliament and published in the *Kenya Gazette* in 2002, coming to effect in 2003 (as the Water Act 2002). Several notable reforms of the Water Act 2002 were witnessed with regards to the management and governance of water resources and provisions in Kenya. First, there was separation of the management of the water resources from the provision of water services. Second, there was separation of the policy making from day to day administration and regulation. Third, there was decentralization of functions to lower level state organs. Fourth, there was involvement of non-governmental entities in the management of water resources and in provision of water services. As such, there was recognition of the minister in charge of water affairs who would be responsible for the Water Resources Management Authority (Part III Section 46) and Water Services Regulatory Authority (Part IV, Section 7) as represented schematically by Jason (2015) in Figure 2.1.

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

Based on the Water Act (2002) a set of institutions for water resources management and water services were established. These institutions are currently under review in the Amendment bill of 2014



Figure 1.1: Schematic Design of the Structures in Water Act 2002

(Source: Jason, 2015)

ST. PAUL'S UNIVERSITY

The Water Resources Management Authority (WRMA) was to be responsible for the allocation of permits and development of water resources' management strategies. Under WRMA were the Catchment Area Advisory Committee (CAAC); and Water Resources Users Associations (WRUAs). The Water Services Regulatory Boards (WSRB) was to license water service providers of more than 20 households. As such, the community-managed water systems needed to obtain the license. Under the WSRB, there were the Water Services Boards (Section 51) and water service providers. The Water Service Boards (WSB) has to identify a service provider to provide water. The water service provider was defined as "a company, NGO or other person,

providing water services under and in accordance with an agreement with a license (Water Service Board)" (Section 53(2)).

In these provisions, some limitations can be identified in the Water Act 2002. First, the community-managed water systems, old or new, needed to obtain license from the WSRB to continue to provide the water service. This was opposed to the previous order where this was not required. This requirement presents a legal pluralism. Legal pluralism refers to a situation characterized by co-existence of multiple normative systems all experiencing validity (Mumma, 2005). For example, in Kenya, rural poor typically live within normative frameworks in which state-based laws are not as applicable and effective as the otherwise customary-traditional norms. Second, the WSBs were prohibited from engaging in direct water service provision, except if no provider was available or willing. This exception provides an opportunity for a WSB that is not willing to release such responsibility to a provider. Third, the role assigned to the non-governmental entities is rather marginal, despite the huge investment that such entities continue to make in the water resource management and water service provision. Fourth, Section 3 of Water Act 2002 vests every water resource in the State. Water resource "…whether above or below the ground…" is therefore owned by the State. The right to use water is through permit (Section 6), implying that the community has to pay for access of a water resource that was purportedly to be owned by them. Finally, the criticisms of the Water Act 2002 include its vesting of all water resources in the State, centralizing control of water resources in the Minister, and subjecting the right to use water to a permit requirement.

ST. PAUL'S UNIVERSITY

1.2.2.3 Changes in Legal and Policy Framework in Kenya's Water Service Provision

Devolution under Kenya's new constitution (Laws of Kenya, 2013) has had wide-ranging implications for the water sector. It recognized access to safe and sufficient water as a basic human right (Article 43(1) (d)); and assigns responsibility of water supply and sanitation to 47 counties (4th Schedule, Part 2, Sec. 11 (b)). The purpose of the Water Act (2016) was to align the water sector with the Constitution's objective of devolution. The Act recognized that water

related functions were a shared responsibility between the national and county governments and gave priority to the use of abstracted water for domestic purposes over irrigation and other uses.

The 2016 Water Act has re-defined roles and responsibilities. Some roles have been renamed from the Water Act 2002, including Water Resources Authority (WRA) to replace the Water Resources Management Authority (WRMA); Water Tribunal (WT) to replace the Water Appeals Board (WAB); and Water Sector Trust Fund (WSTF) replacing the Water Services Trust Fund (WSTF). The other changes include Basin Water Resources Committee replacing the Catchment Area Advisory Committees (CAACs); and Water Works Development Agencies (WWDAs) replacing the Water Service Boards (WSBs). Meanwhile, WASREB and WSP have been retained.

The WRA's objective is to protect, conserve, control and regulate use of water resources through the establishment of national water resources strategy. As well, the WRA is responsible for formulation and enforcement of standards, procedures and regulations for management and use of water resources; planning and issuing of water abstraction permits and setting and collecting permits and water use fees. The WASREB, with the constitutionally guaranteed right to water and the need to protect consumers, provides a strong basis for the national regulation and monitoring of water and sewerage services. This is critical to protect the interests and rights of the consumers from exploitation and set minimum national standards. As such, the functions of WASREB have been maintained in the 2016 Water Act. WASREB holds the mandate to approve tariffs, monitor and enforce water services standards and issue licenses to the Water Service Providers.

The 2016 Water Act provided for the establishment of WRUAs, which are community-based associations for collective management of water resources and resolution of conflicts concerning the use of water resources. The BWRC may contract WRUAs as agents to perform certain duties in the water resource management. The BWRCs will be committees of the WRA whose members will be drawn from stakeholders within the basin and their aim is to achieve water resources at the basin level. The new BWRCs will retain the same regional functions as the

ST. PAUL'S UNIVERSITY

former CAACs, which is to manage catchments, to facilitate establishments of water resource users' associations and to play advisory role to the WRA.

Table 1.1: Regulatory for Water Service Provision

Areas	Global Arena	National Level	County Governments
History	MDG (2000-15) SDG 6; Target 6a and 6? (2015-30)	Water Acts, Chap 372. Sessional Paper 1999. Water Act 2002. Promulgation of CoK (2010). Water Act 2016.	Municipalities and urban centres. Self-help community groups. Promulgation of CoK (2010). Water Act 2002 & 2016.
Nature of Problems	Understanding access to safe and sufficient water as a basic need	Institutional weaknesses, inadequate funding, conflicts due to overlapping roles and responsibilities of key public sectors	Only about 59% of Kenyans have access to safe water. This figure varies from geographic location and residences. The counties being established.
Process effectiveness	Ensure availability and sustainable management of water and sanitation for all	Regulatory process of access, quality, quantity and impact of the use of water.	Continued functionality, reduced non-revenue water; and multiple uses

(Source: Author's Construct, 2021)

The 2016 Water Act defines the national public works as water works whose water resources is cross-county in nature, financed out of the national government's share of the national revenue and intended to serve a function of the national government. These may include assets such as water storage and water works for the bulk distribution of water services. Furthermore, it specifies that development and management of national public works will be undertaken by the WWDAs while the county public works will be a responsibility of the respective country. The 2016 Water Act provides for handing over of the national public works upon commissioning from WWDAs to the county government, joint committee or authority of the county government if the water works assets exclusively rest geographically within their jurisdiction. The WSPs shifted their responsibilities to county governments who now assumed mandate to provide water services. WSPs are responsible for provision of water services within the area specified in their licenses and development of county assets. Currently, WSBs sign service level agreements with the WSPs and the regulator issues licenses to WSB. Under the new Water Act of 2016, the WSPs

ST. PAUL'S UNIVERSITY

must apply again for new licenses to WASREB. Table 2.2 provides a summary of history, nature of problems and process for effectiveness at the global, national and county government levels.

In concluding the legal and policy framework review, a few areas of consideration relevant to this research were noted. First, there are regulatory processes that exist. For example, the Kenyan Ministry of Water has provided the Water Resources Regulations, 2021 for Water Act (2016). However, it is usually the enforcement of rules and regulations provided therein that are not consistently undertaken. Moreover, there are pluralism and multi-agency visits in the enforcement of such regulations. For instance, in Kenya, one needs to visit WRA for drilling authorization permit, National Environment Management Authority (NEMA) for environmental impact assessment and Water Service Provider (WSP) for a letter of no-objection. In this scenario then, the Water Officers from the county and Sub-county offices seem to only supervise the work and investments by county Government. Finally, the establishment of water source, or otherwise, is a powerful political call tool for seeking for or otherwise dissuading communities from voting. With time, when being used for political expediency, then the rules and regulations guiding such establishments are seemingly disregarded.

ST. PAUL'S UNIVERSITY

1.3 Statement of the Problem

Access to at least basic drinking water is about 63% in Kenya (WHO/UNICEF JMP, 2023), with a wide discrepancy between the rural and urban communities. Access to improved water in Kisumu County was 58% (Kisumu CIDP 208, 2022), with some areas like West Nyakach Ward being as low as 22% and Seme Sub-county being 42% of the people. While water service provision is infrastructure intensive with complex engineering processes, a limited number of government and development agencies are unable to start or successfully finish their water projects (Hamlet et al., 2020). Therefore, many funders and development agencies resort to establishing boreholes with kiosks extended from such boreholes, as improved sources of water. Though a noble idea of reaching out to community members, these borehole water kiosks are insufficient in number. Furthermore, they frequently become dysfunctional within a short period of time (Moriarty et al., 2013). For example, while a study reported that 19 of 25 (76%) donor-

funded water projects were non-functional in September 2018 (Nyakwaka & Benard, 2019c), the mapping by Water Department of County Government of Kisumu (CGK) conducted in 2021 showed non-functionality of 24%.

The frequent break down of boreholes and borehole water kiosks implies that the kiosk water service is not available during such time; therefore, not providing the user households with safe and regular water service that were aimed at the time of establishment. The users of such non-functional water kiosks are faced with the options of lacking access to the right quantity and quality of water with the desired regularity. Hence, the users of such non-functional water kiosks revert back to use the water from sources that might not be safe, far distance or insufficient quantity. It is estimated globally that 829,000 deaths are WASH-attributable (Prüss-Ustün et al., 2019), with many countries in SSA countries, including Kenya, having one of the highest disease burden associated with the poor water, sanitation and hygiene. When there is frequent case of the water kiosks, there is reverse of the gains that might had been made on the incidences of water-related diseases, burden on members of the family collecting water from far distance, or loose of regained time and livelihood activities that might have already been realized. Furthermore, the turn-around time before such water systems (kiosks, borehole or piping) are restored to operate, frequency of their breakdown, and continuous operations and maintenance of the water kiosks are key components of the technical designs and governance of such community-based water systems. On the other hand, there is currently limited research conducted and documented on how the kiosk user households' characteristics, technical designs and governance factors influence these dysfunctionalities. Therefore, this study sought to investigate the influence of user households' characteristics, borehole water kiosk technical design factors and governance factors on financial sustainability of community-managed borehole (CM-BH) water kiosk services within Kisumu County in Kenya.

ST. PAUL'S UNIVERSITY

1.4 Research Objectives

1.4.1 General Objective of the Study

The general objective was to investigate the influences of user households' characteristics, governance and technical design factors on financial sustainability of community-managed borehole water kiosk services within Kisumu County, Kenya.

1.4.2 Specific Objectives of the Study

1. To analyze the influence of water kiosk user household characteristics on financial sustainability of borehole water kiosk services.
2. To assess the influence of user household's sense of ownership on the financial sustainability of community-managed borehole water kiosk services.
3. To analyze the influence of water kiosks' technical design and layout on the financial sustainability of community-managed borehole water kiosk services.
4. To examine the influence of borehole water committee governance on the financial sustainability of community-managed borehole water kiosk services.
5. To assess the influence of the user household participation in governance on financial sustainability of community-managed borehole water kiosk services.
6. To examine the significance of land ownership in moderating the influence of the user household characteristics, technical designing and governance factors on the financial sustainability of community-managed borehole water kiosk services.

ST. PAUL'S UNIVERSITY

1.5 Research Questions

The overall question for this study was: What significant user household characteristics, technical designs and governance factors influence sustainability of community-managed borehole water kiosk services? The sub-questions for the study include:

1. What influence does user household characteristics have on the financial sustainability of community-managed borehole water kiosk services?
2. How does user household's sense of ownership influence the financial sustainability of community-managed borehole water kiosk services?

3. How do water technical designs and layouts influence the financial sustainability of the community-managed borehole water kiosk services?
4. In what ways does water committee governance influence the financial sustainability of community-managed borehole water kiosk services?
5. How does the user household's participation in governance influence financial sustainability of community-managed borehole water kiosk services within Kisumu County, Kenya?
6. What is the significance of land ownership in moderating the influence of the user household characteristics, technical designing and governance factors on the financial sustainability of community-managed borehole water kiosk services?

1.6 Justification of the Study

An estimated 844 million people remained without access to improved drinking water within a reasonable distance from home in 2019 (Gomez et al., 2019), while 2.2 billion people lacked access to safely managed drinking water (Khalifa & Bidaisee, 2018). While establishments of water infrastructure are capital intensive and the systems are inadequate, approximately one-third of boreholes across rural Sub-Saharan Africa fail within five years of construction (Behnke et al. 2017). Preliminary mapping of water sources by Kisumu County as at February 2020 established that 24% (70 water points) of the total 292 water points mapped were non-functional; suggesting a breakdown status of 24% of existing water kiosks, the situation seemed to be worsening going by prevailing factors.

The study related to sustainability of community-managed boreholes with multiple water service kiosks in rural areas had not been conducted in Kenya, neither had a model for management been established. Even the Kenya Water Service Regulatory Board (WASREB) only provides for organized water service providers of the County Governments and missed the description the rural community supplies. Several authors have made several suggestions for future study in areas with regard to sustainability. For example, Contzen and Marks (2018) recommended a definition of the full range of explanatory factors of kiosk use, investigation of contextual influences by comparing kiosks in institutional and public kiosk settings and investigation of

ST. PAUL'S UNIVERSITY

whether the underlying mechanisms differ with regard to different antecedents of sense of ownership. This study incorporated some aspects in areas as identified by Contzen and Marks (2018b), including technical and governance factors of water collection kiosks and household water use patterns at the boreholes and kiosks. Furthermore, aspects of extension of additional types of cooperation related to the water collection kiosks' routine maintenance and repairs were explored.

The significance of this study is the enhancement of policies and sustained financial viabilities of water kiosks and enhanced governance of borehole sources and water kiosks at the local levels. The study on the water governance endeavoured to bridge the gaps in knowledge of social context, household engagements in water kiosk governance and the local water policy dimensions. Furthermore, information generated by this study will aid in enhancing the financial sustainability of community-managed borehole water kiosk services.

Globally, national governments seek to implement policies to generate and sustain socio-economic growth and development by increasing productivity and improving the access to safe water and well-being of their people, as established by Cheevapattananuwong et al. (2020). The dilemma is when such water infrastructure development had significant impacts on local communities. Such water projects involved significant acquisitions, which often resulted in the drilling of boreholes, laying pipes and siting kiosks in the lands of the villagers, with possible impact on their means of livelihood and social well-being. The study highlights the critical influence of the ownership of land on which borehole and water kiosks are established on the financial sustainability of the community-managed borehole water kiosks. The seasonality of the use patterns of the water kiosk, strengthened by the perceived sense of ownership in specific administrative areas are also significant contributions that this study makes to the new body of knowledge.

1.7 Scope of the Study

The geographical scope of this study was limited to three Sub-Counties within Kisumu County as at the time of site selection in 2021. The research focused on the user households'

ST. PAUL'S UNIVERSITY

characteristics, technical design and water governance of community-managed borehole and water kiosks within these Sub-Counties. These Sub-Counties included Nyakach, Nyando and Seme which were sampled to represent the rural communities of Kisumu. This study considered community-managed boreholes which had two or more extensions to institutions, public or homesteads as the water service collection points. The borehole or water kiosk must have been handed over for community management through the Water Users Associations (WUAs), with methods of financial revenue generation and spending towards financial sustainability of such projects.

1.8 Limitations of the Study

The study was cross-sectional for the user characteristics, technical designs and water governance, that only looked at both quantitative and qualitative data at one point in time for financial sustainability of community-managed borehole water kiosk services. It did not look at a longitudinal process that would have given data on one aspect at different time span. Therefore, the use of mixed method for data collection from the households, focus group discussions and key informant interviews complemented and triangulated the validity and authenticity of findings established. The second limitation of the study was on the study site, which had predominantly one ethnic community. This might therefore only have generated information and findings of perspective from one such ethnic community on the financial sustainability of the community-managed borehole water kiosk. However, noting that access and use of the borehole water kiosks are usually for villages, which even in other areas of Kenya, are never cosmopolitan but predominantly inhabited by one ethnic groupings, the data and findings generated might be replicated in several rural community-managed borehole water kiosk services.

This study was designed during the COVID-19 pandemic prevalence but the data was collected during the window period of protocol observations. While appreciating that the period was the second and third years of Covid-19 pandemic, it might have precipitated certain impacts on the type of method and tool for data collection and the type of data the respondents and participants submitted. As the study was being organized and data collected, the researcher was cognizant of

ST. PAUL'S UNIVERSITY

the protocols laid by the Ministry of Health and triangulating the information generated from different sources.

1.9 Study Assumptions

This study, investigating influence on the financial sustainability of community-managed water kiosk services made some assumptions. First, the study assumed the water kiosks are the predominant models for providing improved and safe water services in rural areas of Kisumu County. Secondly, the study assumed that most of the water kiosks are dependent on the boreholes as their sources of improved water; and not piping from any other sources. Third, the study assumed that the respondents, key informants and participants understood the aspects of the household water uses, the technical design and water committee governance issues as well as the basic issues regarding financing the activities of the community-managed borehole water kiosks.

1.10 Operational Definitions of Key Terms

Community-managed water service is defined as the model in which the members of the water borehole or water kiosk elect select the water committee members to take charge and oversee the affairs of their community-based water system.

Community water governance is defined as the evolution of the informal networks, partnerships and joint decision-making processes (dialogue and negotiated outcomes) as mechanisms for steering water governance, while addressing efficiency and effectiveness in use of water resources.

Improved water source is a source that is protected from external contamination and can be accessed by a household member within 30 minutes round trip (Gomez et al., 2019).

Interruption of community-managed water kiosk is defined as the period between the water kiosk breakdown, during which the users cannot access the water services, to the time when the system is restored or repaired, and the users can access the water service.

ST. PAUL'S UNIVERSITY

Financial sustainability of community-managed water kiosk is the availability of financial resources for continued service of water supply projects over time to serve their own purposes.

Operations and Maintenance (O&M) is defined as all justified recurrent activities and expenditure incurred by the water committee or operators during their businesses.

User fee (tariff) is the justified price charged for the water kiosk service to cover for reasonable cost of providing the required services at the kiosk.

Water kiosk was defined as a booth or stand tap for sale or dispensing of water to the users who come to fetch water for different needs.

Water Kiosk Service means the point of supply of water services and all other incidental services provided therein.

Water kiosk operator is defined as the person who is stationed at the water kiosk to open and close the kiosk tap, collect money from sale of water (where applicable). In this study, it also included the water attendant or salesperson, as appropriate for the water kiosk management committee.

Water technician is defined at the person who is responsible for repairs, maintenance and or servicing of the water system as appropriate. In this study, it also included the water plumber, as appropriate for the water kiosk management committee.

ST. PAUL'S UNIVERSITY

1.11 Organization of the Study Document

This study is organised into five chapters. Chapter 1 provides the introduction with the background, statement of the research problem, research objectives and research questions and hypotheses. It also provides the justification and the research limitations. Chapter 2 presents the

literature review including theoretical, empirical and conceptual framework for the study. Chapter 3 presents the methodology for the research, including the research philosophy, location context, type of data, tools of collection and analysis of the factors influencing financial sustainability.

Chapter 4 captures the research data presentation, findings and interpretations. First it provides the descriptive frequencies of the data, the associations between sustainability outcome indicators and various independent variable categories. It ends with the interpretations of the influence of the predictor variables on the financial sustainability outcome. Chapter five presents the discussions, conclusions and recommendations from the study. The referencing section has been done using the APA style follows as provided by the Zotero (Version 7.0). Finally, there are appendices attached for the approvals, ethical aspects and tools used.

1.12 Chapter Summary

This first chapter focuses on the context on which the problem under study is founded on. Accordingly, it provides the status of the global, regional, national and local access to safe water from improved sources. Moreover, it describes the context within which water is considered a scarce resource in Kenya, just as is in most regions within Sub-Saharan Africa. Additionally, it explains the difficulties faced in trying to achieve water security in the developing world, such as the complex engineering requirements and infrastructure intensiveness of establishing water points. As a consequence, the agencies that are involved rely on the borehole water kiosks, which though inadequate, are fraught with problems and frequently become dysfunctional at some point after being handed over. To add on, the chapter elucidates on the research problem and the specific areas under scrutiny in this study, namely, the user characteristics, technical designs and governance factors that influence financial sustainability of water kiosk services. It also provides the guiding questions, significance, scope and limitation of the study. It concludes by outlining the operational definitions of the key terms used.

ST. PAUL'S UNIVERSITY

ST. PAUL'S UNIVERSITY

CHAPTER TWO

LITERATURE REVIEW

2.1 Chapter Introduction

This chapter divulges the theoretical framework on which this study was hinged and empirical literature on kiosk water service provision and sustainability of such infrastructure. The theories addressed are the common-pool resource theory and the socio-technology theory. In the process of the review, various assessments towards sustainability of community water supply are presented. Furthermore, the researcher sets down outstanding gaps identified therein. The final section of the chapter encapsulates the conceptual framework on which the variables of this study are premised.

2.2 Theoretical Review of the Study

There are several theories reviewed to be relevant to this study. These included the common pool resource theory (Ostrom & Gardner, 1993), the theory of the tragedy of the commons (Hardin, 1998), social capital theory (Coleman 1990; Putnam et. al 1993; Durlauf & Fafchamps, 2005); socio-technology theory (Ropohl, 1999) and the sustainability theory (Davis & Brikke, 1995; Adams, 1998). The theory of tragedy of the commons postulates that the demand grows in step with population (while supply remained fixed). The social capital theory postulates on the social organization facilitating the achievement of goals with features such as trust, norms, and networks. The sustainability theory postulates that the water provision systems remain and benefits realized while being operational, functional and utilized by the users. However, the common-pool resources (CPR) theory and socio-technical theory were relevant for and used in this study.

2.2.1 Common-Pool Resource Theory

Global progress towards the goal of universal, safely managed drinking water services are shaped by the dynamic relationships between water risks, values and institutions (Koehler et al.,

ST. PAUL'S UNIVERSITY

2018). With this kind of experience, water is always viewed as a natural resource, which ideally is considered as a common resource, which is needed by all human beings, and all other living things. Common-pool resources (CPR) are natural or man-made resources where exclusion is difficult, and yield is substractable. In other definitions, CPR focused on structure of the resource (Ostrom & Gardner, 1993). The authors (Ostrom and Gardner) cited CPR as focused on the property regime related to a resource (or other common property) and the second attribute of private goods. Millions of CPRs exist in natural settings, ranging in scale from in shore fisheries, irrigation systems, and pastures to the vast domains of oceans and the biosphere (Ostrom & Gardner, 1993).

Two attributes of the CPR definition by Ostrom and Gardner are expounded further. First, the attribute on difficulty of exclusion stems from many factors, including the cost of parcelling or fencing of the resource and the cost of designing and enforcing property rights to exclude others from accessing the resources (Pérolat et al., 2017). If exclusion is not accomplished by the design of appropriate institutional arrangements, free riding is expected in the provision of the CPR. After all, what rational actor would help to provide the maintenance of a resource system, if non-contributors can gain the benefits just as well as the contributors? The extent to which a CPR will be provided is a complicated problem, depending on how preferences are articulated, aggregated, and linked to the mobilization of the resources (Choe & Yun, 2017).

The second attribute of CPR is substractability. The substractability is key to understanding the dynamics of how the tragedy of the commons can occur (Baerlein et al., 2015). The resource units (like service of water from water kiosk) that one person appropriates from a CPR are not available to others. Unless the institutions change the incentives facing appropriations of water from, for example water tanks, one can expect substantial over-appropriation. In a similar substractability, a private water vendor using a bowser, who is a member of the water user association, cheaply accessed water from a kiosk (at the domestic use tariff) and selling at higher prices, while reducing the quantity available for other users who do not have such capacity. The private gain is thus very likely to overbalance any single water vendor's share of the social loss.

ST. PAUL'S UNIVERSITY

In the prevailing CPR theory, the temptation to free-ride on the provision of key water infrastructures, such as a kiosk, is viewed as a major deterrent to successful use of the service. Observing other authors, Ostrom and Gardner (1993) described this problem as illustrated in their criticism. One, the logic of the individually rational utility seeker may not coincide with the logic of the community. If for example, a beneficiary individually observes that their leaky and misaligned water piping required improvement, they will not invest in corrective action on individually rational grounds. Assuming a sizeable number of users, each will calculate as follows. If one user invests time, energy and money required improving the channel going through his or her own land and other users do not make comparable corrective investments in a coordinated fashion, then the payoff in improved water supply and control (the collective good) is negligible. This theory is applicable to the objectives regarding the user household characteristics, sense of ownership, perception of and participation in water kiosk governance.

2.2.2 Socio-Technology Theory

Noting the several enhancement of life and livelihood, it would be arrogant for technology to discount social aspects as irrelevant to technical issues (Baek & Lee, 2021). The technology savvy society is affected by the technology it uses, but equally it could socialize the technology it creates. Conversely, the water engineering is complex with technology designs that must be embedded within a social context and needs to engage that context in order to operate and be usable. Without a social direction, technology will not deliver as it envisioned and equally without technology, society will not grow as it should.

One study in the past believed that the research projects should not only attempt to increase knowledge, but also to embrace improvement of work situations that were unsatisfactory in human terms (Ropohl, 1999). This belief led to the development of an approach and methodology, which they called socio-technical. This meant that water engineering technology (machines and associated work organizations) would not be allowed to be the controlling factor

ST. PAUL'S UNIVERSITY

when new water systems were implemented. Equal attention was required for providing a high quality and satisfying work environment for designers, contractors, technicians, plumbers, and operators (Mumford, 2006). In practice, a primary objective of socio-technical projects was to ensure that both technical and human factors should, whenever possible, be given equal weight in the design process. The socio-technical design further had an important democratic component; including that workers who used new systems should be involved in determining the required quality of working life improvements.

The cornerstone of the socio-technical approach in water service provision can only be achieved by a technical design and layout process aimed at the joint optimization of the subsystems (Cartelli, 2007). Any organizational system maximizes performance only if the interdependency of the subsystems is explicitly recognized. Any design or redesign must seek out the impact each subsystem has on the other, and planning must aim at the achievement of superior results by ensuring that the subsystems are working in harmony. The technical subsystem is the sum of the equipment in the organization identified with the process responsible for the conversion of system inputs into system outputs. The conversion process must continuously be controlled to be sure that the system goals can be achieved. On the other hand, the social subsystem is a set of technical control tasks to be performed by people. Technical tasks are combined with individual jobs and with responsibilities assigned to groups. Any analysis and redesign of the social subsystem implies a revision of the jobs and of the corresponding social roles, for the implications they have on the technical subsystem and for the extent to which they chance or reduce the quality of the working of the individuals and groups involved in the production (Cartelli, 2007).

ST. PAUL'S UNIVERSITY

Table 2.1: Grounding the Theories with Research Objectives

Theory and Key Principles	Research Objectives	Key Issues for the Objective
Common-pool resources: • Difficulty of exclusion • Substractability	• Influence of water kiosk user household characteristics • Influence of user households' sense of ownership • Influence of borehole water committee governance • Influence of the user household participation in	• Difficulty of exclusion and possibility of free-ride amongst the users, depending on their participation and contribution. • Once appropriated, the resource might not be available for others • The logic of individual utility seeker might coincide with the community.

	governance • Influence of moderating factors	• Temptation to use technology to cheat by taking more than authorized, access outside agreed time, vandalize.
Socio-technical theory: • Technical systems that ignore social requirement fail • Social systems that ignore technical support do not run well	• Influence of water kiosks' technical design and layout • influence of moderating factors	• Social and technical overlay. • Technical and human factors should be given same weight

In Table 2.1, relationships between the objectives and key concepts of the two theories are established. It is noteworthy that CPR and STT theories are critically overlaid with the research objectives.

2.3 Sustainability in Community Water Supply

The word "sustainable" was first used in 1972 in Two (2) books: *The Limits of Growth* by Donella Meadows and *Blueprint for Survival* in Ecologist Magazine (Phillips & Pittman, 2014) that looked at system dynamics model predicting future levels of global resources, consumption, pollution and population. Since every scenario they fed showed the human crashing mid-way, they concluded that human civilization was approaching the limits for growth on a small planet. Though this was a controversial prediction, the model was revisited in 2002 (Meadows et al., 2004). After almost three decades, they asserted that the initial predictions and projections were relatively accurate. They further asserted that humanity had entered a period of overload in which it was beyond the planet's ability to sustain human society.

Apart from Meadows prediction on future resources, Philips & Pittman (2014) listed four other events towards sustainability in the 1970s and beyond. First, the United Nations Conference on Environment and Development in 1972 brought together researchers and policy makers to explore the humanity's future on the planet. The second occurrence was the Energy Crises of 1973 and 1979 which raised Global concerns as home to the millions of Americans at gas pumps. The third one was the Rio de Janeiro's Earth Summit of 1992 about Global warming. Finally, concerns about sustainability of the financial and food systems in 2010 have spread across many countries. Although for many years "sustainability" was dismissed as a faddish or

ST. PAUL'S UNIVERSITY

overly idealistic term, in the early 21st century, it has become well established as a priority worldwide. There are currently observable variations in the climatic patterns that suggest the changes. For example, sea levels have risen by 10-20 cm since 1900, cod fishery collapsed in North Atlantic and 38% of agricultural land degraded (Meadows et al., 2004).

The term "sustainability," as defined by some authors, refers to the function of a process over time, but does not include specifics on process or activity, its duration, or who may be involved or responsible (Amjad et al., 2015). However, this study was interested in the specifics of the process, activity, duration of service and who was involved and responsible to the continued service provision. Thus, the sustainability to which the study refers was the continued delivery of safe drinking water without resource depletion, interruption nor continued breakdown of kiosk infrastructure. Therefore, as observed, sustainability refers to the general continuation and maintenance of a desirable feature of an initiative and its associated outcomes (or services) as well as the processes taken to adapt and develop in response to emerging needs of the system (Lennox, 2018).

Several authors have provided clarity on definitional and operational use of sustainability. Hodgkin referred to sustainability as the ability of a water supply development project to maintain or expand a flow of benefits at a specified level for a long period after project inputs have ceased (1994). In his observation, the narrowest meaning of sustainability was the project with physical infrastructure established, maintained and operated by the participating institutions. Further, in this observation, there is the aspect of maintaining the continued supply and expansion of flow of benefits. This implies that the infrastructure either was extended beyond the current location of benefit to other points (as kiosks or water points), or while at the current location the number or volume of use are increased. A sustained water supply is "…a service that regularly and reliably provides enough water of an acceptable standard for at least domestic use. Breakdowns are rare and repairs rapid (within 48 hours). Also, local financing covers at least the regular costs of operation, maintenance (O&M) and repairs" (Dayal et al., 2000). In that spirit, the project sustainability is defined as the capacity of a project to continue to deliver intended benefits over a long period of time.

ST. PAUL'S UNIVERSITY

Sustainability involves time with various questions that emerge when assessing the flow of benefits of a borehole water service project over time. First, has the water kiosk project been sustained up to the time it is studied? Due to its relative simplicity in field measurements, functionality over time has been used as a proxy for sustained benefits of water systems such as motorized boreholes. Second, is the water kiosk project likely to be sustainable over its intended lifetime? Third, what is the lifetime of the water kiosk system for sustainability purposes? These water kiosk system outcomes seemed to be similar regardless of the setting (whether community, school or health facility). Outcomes related to benefits provided to the people using the water kiosk system would only change based on the setting.

Sustainability can also involve the notion of equity. In this case the equitable access amongst all members of a population, irrespective of their social status, to continual service at acceptable levels providing sufficient benefits, and reasonable and continual contributions and collaboration from service, consumers, and external participants. Providing service to all members of a targeted population is a goal, although not a necessary or sufficient condition for sustainability of a water supply project. Equitable access refers to inclusion of vulnerable groups.

The vulnerable groups can be described as lower income households, politically disadvantaged (communities perceived to have not voted for or do not necessarily support the current political leadership). The vulnerable groups also include physically challenged populations, who may require special consideration in design and implementation of water systems. The vulnerable groups also consider mainstreaming of specific gender requirements unique for both women and men's access to water services.

Sustainability definitions also include environment (Rusca & Schwartz, 2014). Environmentally, roles of the end user and the water supplier are prominent themes in defining sustainability for water resources that may eventually feed into drinking water systems. For example, sustainable water use could be described as the use of water that supports the ability of human society to endure and flourish into the indefinite future with limited undermining of the integrity of the

ST. PAUL'S UNIVERSITY

hydrological cycle or the ecological systems that depend on it (Torretta, 2013). The themes of water resources and project sustainability actually arise from this. First, the water supply project is sustainable if the water sources are not over-exploited but are naturally replenished, facilities are maintained in a condition which ensures a reliable and adequate water supply and the benefits of the supply continue to be realized by all users over a prolonged period of time. Second, the project process demonstrates a cost-effective use of resources that can be replicated. Water dispensed at the water kiosk comes from a borehole. All borehole water systems are naturally recharged by the underground water systems, so long as the drawing is less than the recharge process. These definitions recognize the distinction and inter-connectedness between the sustainability of a water resource and sustainable delivery of water services. Such definitions also show how sustainability is a building block for the broader goal of sustainable development.

Keeping in mind time, equity and environment as characteristics that make up the definition of sustainability, and how to manage these elements for long-term performance of water projects or services, it is then important to look at the factors of sustainability. Factors of sustainability include technical, community, social, financial, environmental, institutional, policy, durable gender equality, and empowerment. For the purpose of this study, these factors can be separated into project-specific factors and external factors, which affect sustainability but are outside of the control of the project. In the example of water supply in communities (public places or institutions), sustainability of any project is affected by four broad groups of factors: how the kiosk is designed and implemented, how the kiosk is organized, external factors operating at the local, national, and international levels and the responses of intended and actual kiosk beneficiaries.

ST. PAUL'S UNIVERSITY

2.4 Rural Water Supply and User Household Participation

It is estimated that 35% of all rural water supplies in SSA are not functioning (Kilonzo & George, 2017). The Dublin Principles, which recognized water "as an economic good" gave support to privatization of water services. In contrast, a strong movement defended the role of public institutions in provision of basic social services (Hall & Lobina, 2004), but also the wider principle of considering water as a common good (Barlow, 2009). However, the sustainability of

rural water supply programs remains a challenge. Current estimations in SSA suggest that only two out of three water points (WPs) in the continent's rural areas are functional at any given time. In Tanzania, for example, a recent study estimated that 46% of public improved water points in rural areas were non-functional (Mgoba & Kabote, 2020).

There is no doubt as to the prowess of Community Participation (CP) as a tool for success in the water service sector, of which evidence corroborates CP as effective in establishment of optimally function water systems & sustainable rural based water schemes (Ananga et al., 2017). However, Ananga et al. (2017) observed that what was lacking in literature were more specific case studies on factors, which might make CP more effective in water schemes and service systems. However, they provide six set of factors identified as crucial for the success of community management, including adequate incentives, sufficient skills and resources, appropriate processes for water system operations-maintenance, effective inter-organizational relationships, appropriate technology, and effective systems of monitoring, evaluation & feedback (Rondinelli, 1991). In his observation, these components should be taken into consideration in designing and implementing programmes for decentralizing water supply systems through community management. Rondinelli (1991) quoted in Ananga el al. (2017) reiterated similar factors (adequate incentives, sufficient skills and resources, appropriate processes for water systems operations and maintenance, effective system monitoring, evaluation and feedback) as crucial to the success of community managed water projects. Along the same vein, other authors identified awareness and participation, external connection, internal political influence, community cohesion and unity, good timing, competent leadership, stock of human asset, sense of ownership and minimum uncertainty as other critical factors (Njoh, 2006).

ST. PAUL'S UNIVERSITY

2.5 Technology in Community Water Kiosk Networks and Supplies

In the previous years, it was the governments who primarily invested in the development, operation and maintenance of water infrastructure and were mainly concerned with the distribution of water (Kemerink et al., 2016). The study by Kemerink et al. (2016) was for Likii River catchment within the Republic of Kenya, largely concerned with surface water, traditional distribution and current redistribution, for uses beyond just drinking water. It was intended to

factor in irrigation and water for livestock. Thus, for them, the shift in public policies towards primarily steering institutional change processes had seemingly given bureaucrats responsible for water resource management fewer means to influence water resource configurations. After all, such targeted investments could potentially open progressive trajectories for water re-distribution that otherwise most were impossible, leaving small-scale farmers with little chance to increase their water usage and ultimately transform their livelihood beyond subsistence. Therefore it is in the interests of governments, especially those concerned with redressing the colonial past, to adopt a comprehensive approach in public policy that encompasses both physical as well as institutional components (Kemerink et al., 2016).

In a separate study, several borehole water extractions and reticulation exist. However, many such technologies are either non-functional or in need of repairs. Nyakwaka and Benard (2019) further suggest factors responsible for the non-functionality of boreholes and related extensions to also include extreme low yields, inability to raise funds to acquire spare parts, or lack of access to the spare parts. The water extraction technologies for boreholes are categorized into hand-pump or motorized pump. The necessary and universal sustainability factors for rural water supplies from existing literature include effective community demand, local financing and cost recovery, dynamic operation and maintenance (Montgomery et al., 2009). In these authors' observations, dynamic operation and maintenance were critical, and had largely been overlooked by providers, operators, and managers of water supplies. The technology aspect of the design would comprise the materials used for piping layout, establishment of the water kiosk, and how accessible such materials were within the local markets.

Direct investments in infrastructure for marginalized water users and targeting the actual redistribution of water to the users is critical. It might be more effective for achieving equity than focusing exclusively on the establishment of inclusive participatory platforms, setting progress water tariffs or providing security in the access by granting conditional water use permits without effective monitoring of water use (van Koppen & Schreiner, 2014). Though the study of van Koppen and Schreiner was based on management of water services in South Africa, these sentiments are also relevant to Kenya and other SSA states. Thus, for them, they have to re-

ST. PAUL'S UNIVERSITY

define the indicators that were selected to monitor the performance of policy and include actual water flows into the kiosks (Kemerink et al., 2016).

Moreover, actual investments in infrastructural development is better to justify payments for water than the logic put forward currently and might therefore increase the ability and willingness to pay. Would it only be a matter of time before a policy entrepreneur picks up these insights and spins infrastructure back into global policy networks or is there really insufficient political will to redress inequity? The Kenyan study established that the proportion of households with access to piped water supply within a distance of 200 metres at 77%, with only 66% of the basic water requirements of the residents were met (Wagah et al., 2010).

They further found out that only 25% of the households accessed the minimum recommended 50 litres per person per day. It is important to observe that households with low incomes and where investment in water infrastructures are low, both jointly or individually result in reduced access to water services. Hence, Wagah et al. (2010) observed that expanded access to safe water services may only be realized if upfront investment was made on the rehabilitation and extension of existing water networks in addition to upgrading of treatment plant. Such would then reduce cost of maintenance and unaccounted for water, thus making better use of Economies of scale. Any new water ethics and demand-based service delivery should also be adopted for better management.

Kisumu suffers insufficient water service provision and shortages as a result of many factors described by Kanoti et al. (2019). Such factors included, poor surface water quality, low investment in the water sector, high non-water revenue, poor waste disposal management and poor sanitation services. Other factors include the hydro-geological constraints and areal urban spread population growth. The demand for land to construct houses has led to the expansion of city boundaries to once protected areas. The shores of Lake Victoria have been encroached as well as the hilly escarpments. Environmental degradation is evident in Kisumu as well as the surrounding areas. Deforestation and settlement on high gradient areas almost results in increased run-off, which is a negative implication on recharge and flash-floods.

ST. PAUL'S UNIVERSITY

Improving the sustainability of water supply infrastructure is a critical component of expanding access to safe, reliable services according to Marks et al. (2013). Prior research identified a number of factors associated with greater sustainability, including demand-driven planning approaches (Isham et al. 1995; Narayan 1995; Sara & Katz 1998; Whittington et al. 2009); project design and complexity (Khwaja, 2009), project size and age (Kleemeier, 2000); and management-oriented post-construction support (Davis et al. 2008). In addition, practitioners and scholars in this field widely cite the essential role that community 'sense of ownership' for water infrastructure plays in ensuring its sustainability (Manikutty, 1997; Nance & Ortolano, 2007; Whittington et al. 2009; Madrigal et al. 2011). Public investments across water network could be the route to achieve reduction in unaccounted for water, hence increasing accessibility to safe water services (Wagah et al., 2010).

It is difficult to enforce the cost recovery with poor infrastructure and small size networks. The results of other studies provided preliminary empirical evidence on the performance of water utilities in many African countries operated below technical efficiency levels. Only about 12.9 per cent of water utilities operated efficiently compared to their counterparts in developed countries, supporting a commonly held view that Africa's water sector operate at unacceptable levels of technical efficiency (Estache & Kouassi, 2002).

In summary, the gaps coming out of the empirical studies reviewed are threefold. First, the water accessed from the underground from the drilled boreholes was not necessarily safe. The existence of such boreholes side by side, and sometimes high mineral contents might result in faecal contamination, high fluoride and or chloride contents. Secondly, the design and lay-out processes of the materials used, the piping systems and points where the water would be collected will result in the tail-enders and head-enders, both categories with varying access distances. The design and layouts as well as their behaviour might also attract vandalism of the system. Finally, where politicians were involved, there might be failure to follow the laid down procedures and processes that would affect quality and longevity of the system.

ST. PAUL'S UNIVERSITY

2.6 Community-Managed Borehole Water Governance System

A universal definition of governance hardly exists in available literature. Some authors looked at water governance as the evolution of informal networks, partnerships and joint decision-making processes (dialogue and negotiated outcomes). These were considered as mechanisms for steering water governance (Tropp, 2007), while some employed a political sociology approach arguing that water governance was a politically contested domain. Water governance should address equity and efficiency in water resource and service allocation-distribution, water administration based on catchments, the need for integrated water management approaches and balance water use between socio-economic activities and ecosystems (Araral & Wang, 2013). Furthermore, Water governance replaced sustainable water management and integrated water resources management (Biswas & Tortajada, 2010). Water governance also calls for clarifications on roles of government, civil society or private sector; and their responsibilities regarding ownership, management and administration of water resources. In summarizing features of water governance as systematic perspective, Wiek and Larson (2012) considered governance as focus on social actors, transparent and accessible discourse on values- goals; and comprehensive perspective on water sustainability.

Attention is increasingly turning towards sustainability of rural water supplies as much as coverage and access. There is concern on functionality of such water points. Therefore, as the enduring community-based management (CBM) model is up scaled, in-depth scrutiny shifted to functionality of Water Point Committee (WPC) or similar community management organizations (Whaley & Cleaver, 2017). These authors further identified the concern of local institutional and socio-economic landscape; broader governance processes-power dynamics; and the socio-technical interface. Controversially, it appears as though community-based water service governance and ownership is expensive in terms of time required of residents, but also of resources. In effect, local level governance cannot automatically be assumed to overcome inequalities of distribution or access to water (Cleaver & Toner, 2006).

Community water governance is an approach of shift from governmentality to governance (Acharya, 2016). This is a more flexible approach which extends beyond government and the place of its agencies, to a greater sharing of power between the state, market and civil society via

ST. PAUL'S UNIVERSITY

new network and partnership structures. However, according to Acharya (2016) findings in Nepal, further results indicated 14% variance between the community governance and service delivery, showing that the overall practice of governance at community level was malfunctioned, attributed to many factors. First, he attributed this variance of many community-based organizations that do not adopt governance in their approach to development. Furthermore, despite the crisis in governance, some CBOs have participated in the service delivery process. Moreover, this crisis has been a foremost obstacle in the working culture of CBOs. Finally, the analysis further explored the problem from the perspective of socio-economic structure, power politics and interests, institutional issues, and capacity and resource constraints.

In general, the paucity of consistent water sector related data is a key constraint impeding effective progress (Biswas & Seetharam, 2008). It was estimated that 35% of all rural water supplies in SSA are not functioning (Kilonzo & George, 2017). The Dublin Principles, which recognized water as an economic good, supported privatization of water services. In contrast, a strong movement defended the role of public institutions in the provision of basic social services (Hall & Lobina, 2004), and the wider principle of considering water as a common good (Barlow, 2009). However, the sustainability of rural water supply programs remains a challenge. The main challenges are, however, not in the water sector. Governance issues and weakness of institutions continue to contribute to this debate and need to be addressed (Estache & Kouassi, 2002).

It is significant that limitations of bottom-up and demand led approaches be recognized without discrediting their potential for the challenging inequalities (Cleaver & Toner, 2006). Their article concluded with a consideration of some of the tensions in community-driven development. Such tensions raise some important questions about the role of state and external agencies in establishing equity criteria in community-managed initiatives. In their study, though, the community element of the project was reported as least successful aspect, they could not assume that managing water at local level leads to broad community ownership, nor ownership in the interest of all (Cleaver & Toner, 2006). In the study, within Tanzania, while considerable emphasis was given to community participation and ownership, through the UWUA constitution and efforts of external consultants, in practice, community ownership was limited to a small

ST. PAUL'S UNIVERSITY

group of members. The community board was empowered by the project, but arguably at the expense of poorer villagers. Communal labour proved a burden for many, and a contentious issue with regards to enforcement. It is doubtful that community ownership is enhanced through forced communal labour.

Some authors submit water governance could be achieved through interventions including treating water as an economic good, making water a state property, creating water rights, introducing implementable water laws and policies, establishing effective participatory structures and processes and managing water at a basin level. However, these scholars might not have foreseen the changing governance dynamics of community-managed boreholes. Some scholars describe approaches for effective water governance to include "openness and transparency". On this, governance structures should work openly and transparently in financial transactions (setting the payment structure, contribution aspects, collection method, and use and/or saving of the resources) and use an understandable language to the public.

While openness and transparency are great concepts of strengthened sustainability, it is unfortunately difficult to navigate these multiple water points from these same boreholes with just these words alone. For example, who sets the payment structure – committee at the borehole or at the water points? If the collection is at the water points, how much of that collection is remitted to the borehole point, within what frequency? Who makes the decision on the repairs on public water point at the community or at the institution? On 'inclusive and communicative' approach, the authors emphasize stakeholders' participation throughout the process from policy formulation to implementation, in addition to direct communication with stakeholders. These aspects will be looking at dealing with the equity of water use among different households and gender needs; and the inclusion of the poor, sick, aged or disabled members of the communities. Other things to consider include coherence policies and equitable opportunities for men and women in improving their well-being. The other areas of concern include possible overbearing attitudes of some beneficiaries whose land the water service points or piping systems may have been laid; and the messaging of some politicians, donors and funders with regard to the use and user-fee contributions. Further concerns are on the initial training to Water Management

ST. PAUL'S UNIVERSITY

Committee and operators, which requires sufficient dichotomy of oversight role and operation of the systems.

In conclusion, the governing in community-based management (CBM) of community water supply and water service might sometimes be viewed as a panacea of sustainability of those systems. The existing literature and practice seem not to fully agree to this assertion as well as the three categories of expansions from the community-managed boreholes suggesting three user categories existing. There are those that access the water service points at public places, such as at markets or along the road. Additionally, there are users in institutions such as schools or health facilities, and finally, those that have waterlines extended to their private premises or compounds. The water needs and uses by these three categories may not be similar, though they are drawing from the same borehole sources.

2.7 Empirical Studies Reviews

Access to safe water, considered a basic need and human right by many, is far from reality for many people (Bisung & Elliott, 2014). They reported that globally, almost 10% of the burden of disease was attributed to unsafe water, inadequate sanitation and poor hygiene. For example, Bisung and Elliot (2014) reported 1.4 million children deaths each year caused by diarrheal diseases and 88% attributable to unsafe water, inadequate sanitation and insufficient hygiene. In addition, one in five children born in low and middle income (LMI) countries die from child malnutrition associated with repeated diarrhoea or intestinal nematode infections induced by unsafe water, inadequate sanitation and poor hygiene before they reach age five. Further, there were numerous adverse effects of lack of water, sanitation and poor hygiene on maternal and new-born health. Specifically, there were adverse impacts resulting from water carrying by pregnant women and hygiene-related infections during and after delivery. Additionally, health-care facilities including hospitals, health centres and residential care settings required access to safe water and adequate sanitation to provide clean tools. They further ensured adequate hygiene practices among care-givers to reduce the risk of hospital based infections.

ST. PAUL'S UNIVERSITY

The disease burden and economic impacts resulting from lack of access to water, inadequate sanitation and poor hygiene are central to poverty reduction efforts and development concerns in many LMI countries. For example, the cost of treating water-borne and water-related diseases, low productivity resulting from sickness due to unsafe water, productive cost of time spent collecting water, and lack of water for household livelihood activities such as gardening and animal rearing have significant impacts on poverty reduction and community development.

It is Imperative that water supply systems are functioning and sustainable. This would also reduce the time needed to store water over a long period of time, or households incurring additional costs to purchase water storage containers. Some authors observed that the quality of water from improved sources can deteriorate significantly after collection yet the household treatment process aimed at mitigating source and post-collection contamination has been questioned (Schweitzer & Mihelcic, 2012). As well, experts agree that management should take place at the lowest appropriate level where it can be responsive to user demands, justifying why water management in rural areas is often left to the communities. Schweitzer and Mihelcic (2012) summarized four community management principles. These are the participation of, and support from, all sectors within the community, the cost-sharing, control (direct or indirect) over operation and maintenance activities and ownership (perceived or actual) over the water infrastructure.

ST. PAUL'S UNIVERSITY

2.7.1 Empirical Review of Water Kiosk Piped Network Designs

According to Nyakwaka and Benard (2019), two varying technologies are used for water extraction from boreholes. These include hand-pumps and motorized systems. A hand pump is a simple technology to manually pump ground water from a well or a borehole. Common repairs for these include the replacement of worn out cup seals and washers; straightening of pump rods, plunger, foot valve & cylinders; and greasing main or pump handle. From experience across communities, hand-pumps have low initial costs and with no recurrent costs other than operator. However, for the hand-pump borehole, water cannot be distributed beyond where pump is located. As well, reticulation pump cannot be installed in boreholes deeper than 120 metres. The major repairs include replacement of the pump rods, plunger, foot valve, cylinder, rising main or

pump handle (Adams, 2012). The motorized pump technology of water extraction comprises use of oil fuel, solar power or electricity as source of energy. Adams (2012) established a common technology for this was a permanent submersible, used in a deep borehole (more than 120 metres deep). Borehole with motorized pump installed, the water is pumped into a reservoir tank erected at an elevated point with a pipe to the tap or to other extensions.

In the presented cases of the water kiosk services, a number of gaps related to the technical issues can be detected. One, the borehole water yield in a particular area differs from the other. Thus, the yield must be adequate to support extension to the different kiosks and users for that point. Otherwise, the expansion might be undertaken but the yield might not be sufficient for these kiosks. Two, depending on the energy to power the water from the system could either be electricity, fuel or solar. In both fuel and electricity, there is the bill involved pumping the system. Thus, the community utilizing the water must be prepared to pay for that energy. In the case of solar energy, the initial costs for installation are currently considered as high, though the operating the solar system is considered low. Three, the landscape within a community usually varies, as there are higher or lower areas from the borehole point. Depending on where the water reservoir is sited, some kiosks might be served through gravitational flow while others might require pumping. For those that require pumping to the kiosk, there is the additional cost to facilitate that; or the users living on the higher grounds must be forced to walk downstream to access the water from the points, which could be served by gravitational flow.

The fourth area is the high cost of installing or setting a water infrastructure, including the borehole drilling, reticulation and expanding to different kiosks. Though this was for establishing an infrastructure to a school, a study established that it goes to the tune of US$ 18,916 per school (Alexander et al., 2016). In the case where there are several public water kiosk service points to be established, and the existing continuous constraints of funding, there is mentioned gap of quality of materials being used for piping and kiosk system designs. The fifth gap that is closely related to the immediate one is, even if funding was adequate, for the initial infrastructure establishment, the question of the ability to raise funds to acquire spare parts of similar quality; or whether those spare parts are actually available within the local markets. The sixth gap

ST. PAUL'S UNIVERSITY

revolves around where some water kiosks have not been installed with water meters, or if broken down have not been repaired, to monitor the volumes of water consumed at the particular kiosk.

Finally, there is gap with regards to installation of the submersible pumps to the borehole and the piping system. The submersible pump can either be permanently installed or mounted only during the use. Where the pump is permanently installed, there is susceptibility of theft or vandalism, and therefore there is need to have additional security system. In the case where the submersible pump is mounted only when in use, there will be additional need for manpower required to carry the pump to and from the borehole point. In both cases, there is usually unpredictability of when water is needed in one water kiosk or the other.

Improving the sustainability of water supply infrastructure is a critical component of expanding access to safe, reliable services (Marks et al., 2013). Prior research identified a number of factors associated with greater sustainability, including demand-driven planning approaches (Isham et al., 1995; Narayan, 1995; Sara & Katz, 1998; Whittington et al., 2009); project design and complexity (Khwaja, 2009), project size and age (Kleemeier, 2000); and management-oriented post-construction support (Davis et al., 2008). In addition, practitioners and scholars in this field widely cite the essential role that a community's 'sense of ownership' for water infrastructure plays in ensuring its sustainability (Manikutty, 1997; Nance & Ortolano, 2007; Whittington et al., 2009; Madrigal et al., 2011).

ST. PAUL'S UNIVERSITY

2.7.2 Empirical Review of Governance Community-Managed Water Kiosks

Some authors have mentioned that water governance can be achieved through interventions including treating water as an economic good, making water a state property, creating water rights, introducing implementable water laws and policies, establishing effective participatory structures and processes and managing water at a basin level. However, these scholars might not have foreseen the changing governance dynamics of the community-managed borehole water services, like the one shown in Figure 2.2. Select scholars describe approaches for effective water governance to include "openness and transparency". On this description, governance structures should work openly and transparently in financial transactions (setting the payment

structure, contribution aspects, collection method, use and/or saving of the resources); and use an understandable language to the public. While openness and transparency are great concepts of strengthened sustainability, it is unfortunately difficult to navigate these multiple water kiosks and collection points from these same boreholes with just these words alone. This is why it is critical to look at the decision-making role of the community-managed water service systems. For example, who sets the payment structure, the committee at the borehole or at the water points? If the collection is at the water kiosks, how much of that collection is remitted to the borehole point, within what frequency? Who makes the decision on the repairs on public water point at the community or at the institution? On 'inclusive and communicative' approach, the authors emphasize stakeholders' participation throughout the process from policy formulation to implementation, in addition to direct communication with stakeholders. These aspects will be looking at dealing with the equity of water use among different households and gender need, and the inclusion of the poor, sick, aged or disabled members of the communities. Other things to consider include coherent policies and equitable opportunities for men and women in improving their well-being.

In summary, about six gaps were identified in governance and decision-making processes in community-managed water kiosk services. The first gap was the changing paradigm of stakeholders and multiple kiosks serving several users from one borehole point. This requires decision-making on the management of the various kiosks; how the breakdown of one kiosk might affect others, responsibility of servicing the kiosk or repairing any breakdown and sharing of revenue generated from water-user fees. The second area involved skill sets for technicians, operators or attendants. This revolved around the qualifications, the recruitment processes, remuneration and supervision. The third area was participation and involvement of users and beneficiaries in decision-making and management of their water kiosks and water supply system. At this point, the governance structure must decide when and on what decisions the users and beneficiaries will participate in. The fourth area involved setting of payment structures and processes. This would answer the questions of how much to charge, and what the regulatory body guides on that structure, when the payment was to be made and who might be excluded. The fifth area involved enforcement of the decisions made, including managing defaults in

ST. PAUL'S UNIVERSITY

payments and resolving conflicts amongst the users, beneficiaries and members, while the final area involved engagement with external agencies for support (technical, goodwill and financial resources).

However, access to external technical expertise, community management and spare parts availability are promoted as model for managing rural water supply, and critical functions of the governance structures. Klug et al. (2017) provided that external support included financial and or technical support from government or non-government employees. To access such a support, it is assumed that the community actor understands who to contact when a hardware breakdown occurs. Easy access to technical experts was consistent reason for rapid rehabilitation for all hardware rehabilitation pathways. Furthermore, the number of members in water users' association (WUAs) and the number of women in executive positions is important. Other important aspects are the number of meetings held, the number of administrative permits granted or the amount of water fees paid might be very informative for other purposes but so far said little about the actual distribution of common pool resources among users (Kemerink et al. 2016).

2.7.3 Empirical Review of Beneficiary Characteristic of Water Kiosks

With regards to this study, there are three categories of expansions from the community-managed boreholes. The category of water users for kiosks includes the ones accessing the water service points at public kiosks, including within markets or along the road. These may be the low-income level users. Their behaviour might compel them coming along with their clothes, dishes to wash at the service points or may come to bathe as well. For a rational household, such would ensure water collected is restricted for drinking and cooking, and less for these other needs. In the foregoing, it is therefore critical to note the variations in water needs and uses by different categories of users at local water kiosks.

With the importance of the different socio-demographic issues (such household income, gender, age, household sizes) and the variations in use or behaviour call for management of systems. One such study raised several implications for water planning across Kisumu County (Price et al.,

ST. PAUL'S UNIVERSITY

2018) with three (3) groups studied foreseeing groundwater remaining as part of the domestic water source mix (mostly groundwater or mix) until 2030. As such, the public health risks of groundwater use alongside intensifying use of on-site sanitation were not perceived as a transitory problem, but in the long term needed to find a solution. From such outputs of the groups studied, it was apparent there was far greater uncertainty over the future. According to Price et al. (2018), such uncertainty reinforced calls for participatory planning approaches, targeted to localities across Kisumu County.

Findings from urban slums, where partnerships such as delegated management model (DMM) were implemented. Other interventions such as educating households on safe water storage practices within homes, were also required to ensure the potential of such models to improve service and health outcomes were fully realized (Nzengya, 2018a). Nzengya's (2018a) findings established diarrheal diseases which slum dwellers suffer from were largely associated with in-access to clean water. While the incidences of diarrheal diseases resulting from consumption of unsafe water was already mentioned, it is important to note that the water storage practices along with the containers of collection are as critical in the rural areas as they are in the slums.

In conclusion, it is critical to note that users' behaviour, their worldview, needs and activities of target beneficiaries but also general population have a critical contribution towards the sustainability of community-managed borehole, water service collection and the system layout & designs. The beneficiary user needs, socio-demographic factors, water collection and storage containers, reliance on alternatives sources especially during different seasons are important aspects of characteristics of the beneficiaries. Such behaviours will revolve around their use of the system, contribution to establishment, operation and maintenance, use or disuse of the same, but also issues of vandalism. Furthermore, the users' perception to leadership, adherence to rules and instructions by management are other aspects inherent to users.

2.7.4 Empirical Review of Sustainability Community-Managed Water Service

This section examined empirical studies undertaken towards sustainability indicators, especially concerning financial and utilization for community-managed borehole water service system.

ST. PAUL'S UNIVERSITY

According to Alexander et al. (2016), water programs can increase the health, dignity and comfort of beneficiaries. However, understanding the construction and related post investment of water facilities and services is one essential piece to make such more sustainable. Current expenditures for water facilities by internal (self-help groups, associations) or external (NGOs, government, donors) sources, was estimated about USD 18,916 per facility. This level of investment, though including drilling costs, is a huge sum for community members to raise amongst themselves. There is limitation of studies on costing of expanding or pipeline extensions to kiosks. The findings illuminate a possible tension between financial sustainability and universal access. If sustainable development goal of safe water for all is to be realized, policy makers and practitioners would need to address this issue, in ensuring rural water services are sustainable and inclusive (adapted from Foster & Hope, 2016).

Water policies in many SSA countries stipulate that rural communities are responsible for self-financing their water point's operation and maintenance. In the absence of policy consensus or evidence on optimal payment models, rural communities adopt a diversity of approaches to revenue collection (Foster & Hope, 2017). Although the monthly contribution level remains relatively stable above a collective payment rate of 60 per cent, there is little evidence of self-sustaining growth beyond this point, and revenue collection is prone to collapse below this collective payment threshold. In comparison, pay-as-you-fetch fees were associated with increased revenue and improved operational performance, but result in a higher proportion of households opting for an unimproved water source (Foster, 2016).

However, among the identified factors, there are two unique contributors, including provision of dividends to the beneficiary community and extent of the institutional formations as established by Ananga et al. (2017). The formation of strong institutional structures can be a recipe for success in any organization. The institutional structures results in clear billing procedures, well-defined roles from then management to water pump attendants, helped in creating an amicable working environment where there is minimal duplication of duties. As concerns the dividends provision, the ability to plough extra-generated revenue from the venture into other community activities, improving the community sense of ownership and facilitating the day-to-day

ST. PAUL'S UNIVERSITY

maintenance requirements of the systems also requires consideration according to Ananga et al. (2017). These findings suggested collections of user fees were significant determinant of water point sustainability, alongside other institutional, technical, geographical and environmental variables.

One study shed light on the relationships between revenue collection approach, the financial and operational performance of water points, and the water source choices of the households in rural Kenya. The revenue collection from Kwale county suggested that pay-as-you-fetch water points generated more income and experienced shorter downtime than water points with flat fee arrangements (Foster & Hope, 2017). The trade-offs were that a higher proportion of households opt to use an unimproved drinking water source, either because of the increased excludability, the higher unit cost of water, or a combination of the two. Thus, in Kwale, neither pay-as-you-fetch nor flat fee arrangements could be said to achieve the twin goals of sustainable and universally accessible water services. Further investigation is required to understand why some communities independently choose pay-as-you-fetch arrangements, and the extent to which there is a community consensus on the adoption of an exclusionary model that accepts higher costs and unimproved drinking water use in exchange for superior operational outcomes.

As a wrap on gaps in financial sustainability, the indicators would include investment incurred for the facilities and the source, monetary and non-monetary contributions, revenue collection methods, billing procedures and dividend provision for the beneficiaries. Furthermore, this study would examine record keeping of sales, budgeting and expenditure, seasonal variation of use as well as alternative resource mobilization.

ST. PAUL'S UNIVERSITY

2.8 Summary of Reviewed Gaps for the Study

The main aim of this study was to investigate the influence of user household characteristics, technical and governance factors influencing sustainability of community-managed water kiosks service in Kisumu County, Kenya. Several works done on the community managed water service technical designs and governance practices have not shown how such findings would strengthen sustainability of community-managed water services, much as water-user associations do exist.

Kisumu County in Kenya was selected for 'her' geographical attributes for study implementation which allowed for in-depth analysis into these critical elements.

The UN Sustainable Development Goals categorized SDG6 to ensure availability and sustainable management of water and sanitation for all; and this has been shown to be related to seven other SDGs (Blanc, 2015)). Safe drinking water, while abundantly available in some countries, remains a scarcely available communal resource in some regions worldwide as explained by Contzen and Marks (2018). It is also estimated a quarter of Global population still depends on unsafe drinking water supplies impacted by faecal contamination according to Onda, LoBuglio, and Bartram (2012). Furthermore, Prüss-Ustün et al. (2014) established Consumption of unsafe water was responsible for over 500,000 deaths annually due to diarrheal disease. Countries across SSA have particularly low levels of access to safe drinking water. Kenya typifies regional characteristics according to WHO/UNICEF Joint Monitoring Programme (2015).

Population residing in rural areas but only about half of rural households could identify an improved water point as their main drinking source. It was these factors which prompted the review of relevant journals-studies on community water governance, community participation, ownership and sustainability. These resources illuminated underlying problems, but also research gaps for further investigations. The next section outlines the identified research gaps by selected authors to some of these journals and a categorization of emerging gaps.

According to Ibrahim's (2017) findings, there were identified four recommendations towards sustainability of rural water supply. First, observation that the success of community-based model (CBM) models in ensuring functional sustainability of point-water facilities largely depended on the ability and willingness of water users to participate in water-related community development initiatives. This was by making financial contributions to meet initial cost of construction, major repairs and routine O&M. Secondly, although all projects investigated in the current study had a financial contribution mechanism to sustain their project, their financial ability was still limited especially if the project running costs were beyond their financial limits. Therefore, sustainable community-based water service (CBWS) project required internal

ST. PAUL'S UNIVERSITY

cooperation as well as external assistance. Further, the governmental and/or other stakeholders' intervention was required to ensure the projects' functionality and sustainability. Finally, they recommended the need to develop models and mechanisms for supporting and backing up communities in managing projects upon completion. Ibrahim's (2017) study concentrated on open surface water points; however, the current study would be limited to community-managed borehole and extended water service collection points.

2.8.1 Empirical Research Gaps in Community Water Service Provision

The first paper of *"Challenges for Water Governance in Rural Water Supply: Lessons Learned from Tanzania"* focused on the identification and analysis of key issues which impacted the governance of rural water services in sub-Saharan Africa as established by Jiménez and Pérez-Foguet (2010). Tanzania was selected as a representative case study with analysis based on a combination of relevant literature review, extensive fieldwork and action research case studies, carried out from 2005 through 2009. A number of weaknesses that continued undermining strategies for poverty eradication were identified at different administrative levels (from local to national); including low quality of water services, lack of sustainability of constructed infrastructure, difficulties for targeting the poor and inadequate internal information systems. Other relevant studies showed demand responsiveness did not significantly influence sustainability, as established by Masduqi et al. (2010), probably because the characteristic of community in East Java varied from those across other developing countries. However, (Katz & Sara, 1997) recommended demand responsiveness as important factor towards rural water supply sustainability.

The paper by Behnke et al. (2017) on *"Resource mobilization for community-managed rural water systems: Evidence from Ghana, Kenya, and Zambia"* reported that rural water systems in SSA were often managed by community water committees. For these systems to be sustainable, the committees must mobilize resources for O&M, or upgrade of their water systems. In their observations, some committees collected a monetary water fee, but other options were available in rural communities in Ghana, Kenya, and Zambia. They identified several non-monetary and non-fee mechanisms, including mobilization of personal and community assets, community

ST. PAUL'S UNIVERSITY

institutions, and community labour. For the future research, they suggested revising monitoring survey questions to include the non-monetary and non-fee resource mobilization mechanisms.

In their findings on *"Sustainability of Community Based Water Projects: Dynamics of Actors' Power Relations"* (Marks et al., 2013a) noted that community sense of ownership for rural infrastructure was widely cited as a key factor towards sustainable service delivery, but no empirical investigation had evaluated the relationship between sense of ownership and sustainability outcomes. The study examined association between system sustainability and ownership among households and water committees. Using principal components analysis, the authors created composite measures of system sustainability (infrastructure condition, users' confidence, and on-going management), and of water committees' and households' sense of ownership for the system. With all other factors held constant, infrastructure condition was positively associated with water committees' sense of ownership, whereas users' confidence and system management were positively associated with households' sense of ownership. The researchers did not suggest any glaring gaps for future investigation.

ST. PAUL'S UNIVERSITY

Table 2.2: Selected Research Gaps for Community Water Service Provision

Research Title	Identified Gaps & Recommendations	Objectives.
1. Resource mobilization for community-managed rural water systems: Evidence from Ghana, Kenya, and Zambia	• Revising monitoring survey questions to include the non-monetary and non-fee resource mobilization mechanisms.	• Technical design and layout. • Governance decision making
2. Structural equation modelling for assessing of the sustainability of rural water supply systems	• Demand responsiveness did not influence sustainability significantly (Masduqi et al., 2010), probably because of the characteristic of the community in East Java that might not be the same as the community in the other developing countries. • Other authors recommended considering the demand responsiveness as an important factor to make rural water supply sustainable	• Technical designs and lay out. • Governance decision making
3. Does sense of ownership matter for rural water system sustainability? Evidence from Kenya	• Relationship between different facets of rural water sustainability	• User household sense of ownership financial sustainability
4. Increasing the regular	• Other factors external to those examined explain the outcome	• Moderating factors

	use of safe water kiosk through collective psychological ownership: A mediation analysis	of kiosk use • Investigate contextual influences, for example by comparing kiosks in urban and rural settings • Investigate additional antecedents, including upfront cash and labour contributions toward kiosk installation • Test the assumption that sense of ownership explains investment of effort and personal sacrifices	of geographical location, ownership of land on which kiosk is established. • User household characteristics and patterns. • User household sense of ownership
5.	"Sustainability Assessment and Identification of Determinants in Community-Based Water Supply Projects using Partial Least Squares Path Model"	• CBM in functional sustainability of point-water facilities largely depended on the ability and willingness of water users to participate in water-related community development initiatives, especially by making financial contributions to meet the initial cost of construction, major repairs and routine O&M. • All projects investigated in the current study had a financial contribution mechanism to sustain their project, their financial ability was still limited especially if the project running costs were beyond their financial limits. • Sustainable CBWS project required internal cooperation as well as external assistance. Further, the governmental and/or other stakeholders' intervention is required to ensure the projects' functionality and sustainability. • Need to develop models and mechanisms for supporting and backing up the communities in managing their projects after their implementation.	• Technical designs and layout of the water kiosks. • Users' households' participation in water kiosk governance •

Author's Construct (2021)

One other article *"Does sense of ownership matter for rural water system sustainability? Evidence from Kenya"* observed that community sense of ownership for rural water infrastructure was widely cited as a key factor in ensuring sustainable service delivery, but no empirical investigation had evaluated the relationship between sense of ownership and sustainability outcomes (Marks et al., 2013a). Recommendations called for future investigation into relationships between the different facets of rural water sustainability.

The seventh paper reviewed was, *Water Governance in Tanzania: Performance of Governance Structures and Institutions* by Kabote and John (2017) argued water governance was becoming imperative because of increasing water shortage for different uses in the world. However, the concept was not explored sufficiently in developing countries such as Tanzania. The paper examined water governance in the lines of governance structures and institutions in the Southern Agricultural Growth Corridor of Tanzania. The results showed presence of weak water

ST. PAUL'S UNIVERSITY

governance structures and institutions that cannot influence water users' behaviour. The basin level was unable to control and monitor water quality because of lacking human resource and adequate funding. The formal and informal institutions were interlinked in their operations. However, village governments and village water committees were unable to resolve water conflicts following collusion by those who breached the rules. Therefore, concerted efforts were called for in building capacity of governance structures to enforce institutions in managing water resource. The author seemingly did not present any research gaps for future research. Table 2.3 provides the connections with the identified gaps as aligned to the research objectives.

2.8.2 Categorization of Research Gaps

The eight journals reviewed yielded several research gap areas, which were further categorized into three areas. These were research areas requiring other theoretical perspective; those on methodological investigation; and variables requiring further investigations.

2.8.2.1 Theoretical Perspectives Gap Areas

The theoretical gap areas requiring further investigations were fourfold. First, there was need for creating understanding of social and environmental factors which drive long-term use and sustainability of water and sanitation interventions. This understanding would probably look at more of the social and environmental factors as embedded in eco-social theory. Second, there was need to investigate the theoretically informed community hygiene behaviour change interventions embedded within the social structures. What assumptions, practice and behaviour guide community members in the use of hygiene and sanitation facilities? The third gap was on testing the assumption that sense of ownership explained investment of effort and personal sacrifices. The ownership concept posits accepting responsibility, being held accountable, taking initiative, and/or using own judgement towards a facility. The ownership concept is about the right to possess a water point, sanitation or hygiene facility, among others. Lastly, the theoretical gap area was considering whether both types of norms are implicated in the relationship between social capital and alternative water support. This would require an investigation on the

ST. PAUL'S UNIVERSITY

normative, including the social norms, understanding of social capital and alternative water source.

2.8.2.2 Methodological Gap Areas

There were four research gap areas that related to the methodological investigations. First, it was revising the monitoring survey questions to include the non-monetary and non-fee resource mobilization mechanisms. This research gap assumed current monitoring survey questions focused on monetary and fee-based resource mobilization mechanism. Thus, having proven that the non-monetary and non-fee resource mobilization was possible for the water committee's ability to finance the O&M, repair, and upgrade of its water systems, which is critical to the sustainability of rural water supply systems and has implications for equity and water system reliability and access (Nikki, et al., 2017), these non-monetary and non-fees mechanisms need to be included in the monitoring questions.

The final research gap area on methodological processes included examination of effectiveness of engagement initiatives that aim to strengthen social capital. It assumed a level of community engagement in which community members and organizations were actively involved in common design, delivery and evaluation of any intervention that affects them (Adamson et al., 2014). The authors observed that this represented a very high level of community involvement, which was rarely achieved in practice. The primary determinants of effectiveness are involvement and trust while setting of expectations would help create motivation. According to Osborne and Hammoud (2017) a leader's capability to successfully leverage engagement strategies is essential to organizational achievement. Broadly speaking, social capital is defined as a collective asset in the form of shared norms, values, beliefs, trust, networks, social relations, and institutions that facilitate cooperation and collective action for mutual benefits. By applying effective engagement strategies, organization and community leaders could achieve improved performance and yield greater project ownership and sustainability.

ST. PAUL'S UNIVERSITY

2.8.2.3 Variables Requiring Further Investigations

These variables were numerous and may not benefit from the detailed exposition as the first two areas. In some cases, some may have appeared in either the theoretical, methodological or both, depending on perception by the author. Some of these variable research gaps included creating understanding of social and environmental factors which drive long-term use and sustainability of water and sanitation interventions; and relationship between different facets of rural water sustainability. Other areas noted were factors external to those examined explain the outcome of kiosk use; investigation of contextual influences, for example by comparing kiosks in urban and rural settings; investigation of additional antecedents. Such may include upfront cash and labour contributions toward kiosk installation. Other variable gaps included examination of factors and how community involvement interacted with other elements of social capital in contributing to support for alternative water sources; examination of effectiveness of engagement initiatives that aim to strengthen social capital; and examination of the role of social capital in the context of specific alternative water schemes. The examination of effectiveness of engagement initiatives that aim to strengthen social capital was examined in detail at the methodological gap area.

The universalization of drinking water in rural communities poses a great challenge to developing countries, where rural areas often receive poor water service coverage and limited attention from authorities according to Machado et al. (2019). The relationship between different facets of rural water sustainability was noted as a research gap area. Several rural communities in rural derive water supply through hand pump operated water supply wells. The issue of weak sustainability of rural service provision is not new and has received widespread attention over the past decades according to Bank (2017), who further argued Demand-Response Approach of the 1990s proved insufficient to address sustainability. Since the 2000s, more emphasis has been placed on post-construction support, diversification, and professionalization of rural service providers, including the role of the private sector.

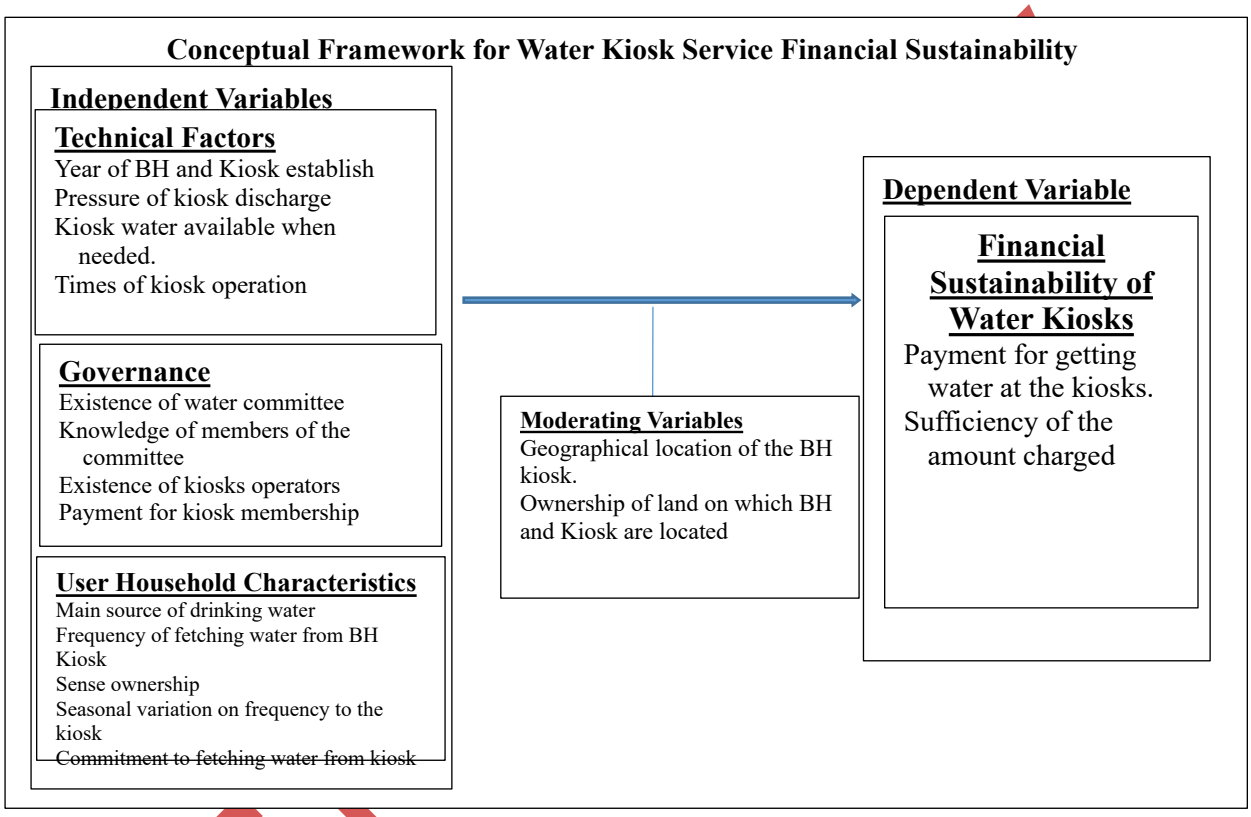
With such a background, these research gap areas were found to bear some semblance of relationship. Therefore, out of preference, this study selected six research gap areas selected out of 16 for consideration. These included the relationship between the different facets of rural

ST. PAUL'S UNIVERSITY

water sustainability, contextual differences of kiosks in urban and rural settings and the assumptions of sense of ownership. Other gaps selected were additional antecedents of upfront cash-labour contributions and effectiveness of engagement initiatives towards social capital.

2.9 Conceptual Framework in the Factors of Sustainability of Water Kiosk Services

2.9.1 Conceptual Framework



2.9.2 Operationalization of the Conceptual Framework

Using the information and concept presented in the empirical reviews and analysis, key variables can be derived with their respective indicators. The identified variables are categorized into the dependent, independent, moderating and mediating variables. Sustainability of the community-managed borehole (CMBH) water service system has been categorized as the dependent variable. The indicators associated with sustainability will be water point functionality and utilization financial indicators (accountability on resources, cost recovery, user fees, financial

record keeping, resource mobilization, etc.), social indicators (including equity, inclusion and satisfaction) and environmental risks (quality, quantity and safety at the point).

Table 2.3: Linking Study Objectives with Variables

Objectives	Questions	Variable	Variable Types	Variable indicators
To investigate the influences of user households' characteristics, governance and technical on financial sustainability of community-managed borehole water kiosk services within Kisumu county, Kenya	What significant user household characteristics, technical designs and governance factors influence sustainability of community-managed borehole water kiosk services?	Financial sustainability	Dependent variable	• Pay to collect your water from the kiosk • Sufficiency of amount charged for running of the water kiosks • Kind of containers do you use to fetch and transport water from the Borehole water kiosk
To establish the influence of water kiosk user household characteristics on financial sustainability of borehole water kiosk services within Kisumu County, Kenya.	In what ways do user household characteristics influence the financial sustainability of community-managed borehole water kiosk services? kiosk services?	User household characteristics	Independent	• Main source of drinking water • Frequency of fetching water from BH Kiosk • Seasonal variation on frequency to the kiosk • Commitment to fetching water from kiosk
To assess the influence of user households' sense of ownership on the financial sustainability of community-managed borehole water kiosk services within Kisumu County, Kenya.	How does user household sense of ownership influence the financial sustainability of community-managed borehole water kiosk service	Sense of ownership	Independent	• Payment of membership • Community own the water kiosk • Village people own the water kiosk
To determine the influence of water kiosks' technical design and layout on the financial sustainability of community-managed borehole water kiosk services within Kisumu County, Kenya.	How do water technical designs and layouts influence the financial sustainability of the community-managed borehole water kiosk services?	Technical factors	independent	• Year of BH and Kiosk establish • Pressure of kiosk discharge • Kiosk water available when needed. • Times of kiosk operation
To examine the influence of borehole water committee governance on the financial sustainability of	What ways do water committee governance influence the financial sustainability of community-managed	Perception on committee governance of the water kiosk	independent	• Existence of water committee • Knowledge of members of the committee • Existence of kiosks

ST PAUL'S UNIVERSITY

community-managed borehole water kiosk services within Kisumu County, Kenya.	borehole water kiosk services?			operators • Payment for kiosk membership
To establish the influence of the user household participation in governance on financial sustainability of community-managed borehole water kiosk services within Kisumu County, Kenya.	In what ways do the user household participation in governance influence of on financial sustainability of community-managed borehole water kiosk services within Kisumu County, Kenya?	Participation of user household in governance of the water kiosk	Independent	• Member of management • Member of committee\ • Attended previous meeting with users • Contributed towards establishment
To ascertain the influence of moderating factors on the financial sustainability of community-managed borehole water kiosk services within Kisumu County, Kenya.	Are there moderating factors that influence the financial sustainability of community-managed borehole water kiosk services?	Supporting the independent and dependent variables	Moderating variables	• Geographical location of the BH kiosk. • Ownership of land on which BH and Kiosk

(Author's Construct, 2023)

2.10 Chapter Summary

This chapter has presented the theoretical framework that provided the common pool resource and socio-technical theories used for this study. More importantly, it brings forth the correlation of the research objectives with these theories. Moreover, it gives an account of the concept of sustainability in community managed water supply as well as the history, legal and policy framework of water service provision at the global and national level. Over and above that, it addresses literature rested on the independent variables which this study sought to explore. Other than that, the chapter presented the empirical reviews on water kiosk water line designs, governance of community water services, beneficiary characteristics of water kiosks and sustainability of community managed water services. In the critique of all this literature, the researcher outlines existing knowledge gaps that require plugging through further inquiries. In its terminal part, the chapter presents the conceptual framework of the study and operationalization of the study indicators. This conceptual framework displays user household characteristics, governance and technical factors as the independent variables and the geographical location of the borehole kiosk and the ownership of the land on which the borehole kiosk is situated as the

ST. PAUL'S UNIVERSITY

moderating variables. The dependent variable is sustainability of the water kiosks and its indicators under study are financial.

ST. PAUL'S UNIVERSITY

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Chapter Introduction

This chapter presents a detailed account of the research methods followed in this research. It begins with an exposition of the research philosophy informing the study. This is followed by a description of the research design and an overview of the specific study site in Kisumu County with a focus on borehole water service providers and water service provision accessibility coverage. The subsequent sections reveal the target population, sampling techniques applied to arrive at the desired sample size, data collection tools employed, pretesting of qualitative and quantitative data collection tools, data analyses procedures and eventually the ethical approval procedures that were followed during the study.

3.2 Philosophical Foundation Informing the Research Design

A paradigm is a worldview, "a universally recognized scientific achievement that for a time, provides model problems and solutions for a community of practitioners" (Kuhn, 1996); or a "perspective or thinking or school of thought - set of shared beliefs that inform the meaning or interpretation of research data" (Kivunja & Kuyini, 2017). The four elements of a paradigm include ontology (the nature of reality), epistemology (the nature of knowledge), axiology (the researcher's values and morals influence research), and methodology (Kaushik & Walsh, 2019; Gray, 2013; Creswell, 2013). There are several paradigmatic positions that researchers take (Kivunja & Kuyuni, 2017).

The positivist tradition had its earliest proponents assume that human phenomenon could be studied the same way physical phenomenon was studied in the physical sciences. The ontology of positivism proponents assumed a single universal reality outside there of which it is

ST. PAUL'S UNIVERSITY

independent of the knower. Positivists advocate for an objectivist epistemology, where the researcher is impartial and does not influence the outcomes of research. As such, the earlier proponents of positivism devalued the role of human emotions, free will, morality, and chance which made the tradition fall under a lot of criticism (Creswell, 2013; Hughes & Sharrock, 2016).

The second paradigm of interpretivism (or constructivism) arose due to criticism that was launched to positivism. It assumed a relativist ontology where there are multiple realities outside there and advocated for a constructivist epistemology, where meaning and truth are socially constructed. In this case, the participants have the subjective meaning of their experiences and the researcher has to draw as close as possible to the participant to be able to capture the multiple views (Creswell, 2013). Interpretivist researchers have to position themselves in the research they are undertaking. It embraces bias in research and uses an inductive approach and tends to use open-ended questions. It assumes a naturalist methodology and a balanced axiology.

The third paradigm is the critical paradigm (or transformative paradigm), which is situated in social justice issues and assumes research is not neutral as such. Both positivists and interpretivists fail to identify forms of oppression and subordination. Since it seeks to transform the politics, and address social oppression-social justice, critical paradigm is at times called transformative paradigm (Kivunja & Kuyini, 2017; Rahi, 2017). The agenda of these studies are to emancipate and empower. This paradigm assumed a transactional epistemology, where the researcher interacts with participants; an ontology of historical realism especially in regard to oppression; a dialogic methodology; and axiology that respects cultural norms (Kivunja & Kuyuni, 2017).

The fourth paradigm is pragmatism, which arose from philosophical critics who argued that there is a need to discover the truth using multiple ways rather than as positivists advocate postulate for a single reality or the interpretivists for social reality. This method sought to bridge the paradigmatic wars that existed between positivists and interpretivists paradigms (Kaushik &

ST. PAUL'S UNIVERSITY

Walsh, 2019; Kivunja & Kuyini, 2017). The proponents advocate for a combination of methods, described as mixed methods; and a plurality, which together they shed light on the actual behaviour of the participants, their beliefs and consequences of those beliefs. It advocates for relational epistemology (these are relationships, which the researcher considers as appropriate for a particular study). The pragmatists' ontology is non-singular; that is, every participant has his or her own unique interpretation of reality as opposed to a single reality.

The mixed methods methodology is the design that this study adopted. It combined qualitative and quantitative research designs and value-laden axiology (values have a place in research). These paradigmatic wars were considered counter-productive in the research of financial sustainability of community managed water kiosk systems. The pragmatic paradigm gave the researcher an opportunity to learn and use both traditions in qualitative and quantitative approaches (Onwuegbuzie & Leech, 2005).

ST. PAUL'S UNIVERSITY

3.2 Research Design

The researcher followed a mixed-methods design. This design was considered appropriate for this study because it allowed extensive data collection from a large population of borehole water kiosk service users at one time, while establishing, enabling and describing the situation as it is by the kiosk operators, water officers and selected committee members (Creswell, 2013). It involved collecting and analyzing both quantitative and qualitative data from the study area; thus adopted as a suitable method for addressing the research issues among the selected population. The use of mixed method design had the advantage that it provided a broader perspective and brought out deeper understanding (Schoonenboom & Johnson, 2017) of the household water kiosk use characteristics; water committee governance of the water kiosk services; and technical designs and lay out of borehole water kiosk systems. As well, the mixed method design brought out complementarity of responses from respondents and participants that produced expanded and enriched understanding of the study (Greene et al., 1989). Thus, the use of the mixed method design strengthened and expanded the researcher's ability in triangulation of the data findings, validity of those findings and enriched the conclusions from the study.

3.3 The Study Area

The study site was comprised of three Sub-counties, namely Nyakach, Nyando and Seme. These Sub-counties were considered appropriate given the research objectives because majority of the rural residents rely on community-managed water kiosks receiving water from community-managed boreholes. During the last ten or so years, several non-governmental organizations (NGOs) and Government agencies have invested in the rural water development to accelerate accessibility, especially drilling of boreholes and establishing of the water kiosks. The three sub-counties have several surface water resources namely, lake, water pans, unprotected springs, seasonal and permanent rivers. The challenges facing the surface water resources in the region include the seasonal flow and availability of water; seasonal flooding from the permanent rivers; and impact of the climate change, among others. Other areas of water issues include inadequate water infrastructure; weak water governance; impact of climate change; and unexploited potential water sources e.g. rainwater harvesting. Other issues include old dilapidate water facilities (outlived design period); inadequate regulatory framework; weak coordination among government agencies; and environmental degradation.

The main sources of livelihoods in the three sub-counties include the crop production and productivity; livestock production; fisheries production; and businesses related to these productivities. The issues low crop production and productivity; inadequate access to quality and affordable farm inputs; low soil fertility; inadequate farmers capacity (access to credit, etc.); effects of climate change; traditional agricultural practices; inadequate extension service providers; prevalence of pests and disease; and high reliance on unpredictable rain-fed agriculture. Some of the issues of low livestock production include inadequate access to quality and affordable farm inputs; inadequate farmers' capacity (access to credit, etc.); effects of climate change; traditional livestock husbandry practices; reliance of traditional animal rearing and keeping; reliance on unpredictable rain-fed pasture production; inadequate knowledge and skills in animal welfare; and inadequate extension services.

ST. PAUL'S UNIVERSITY

There are seven Level-4 health care facilities within Kisumu County. Major health burdens in the three sub-counties are water, sanitation and hygiene related illnesses. According to a study by Baker et al. (2018), poor quality water for drinking was reported to be a major health care challenge. Other WASH-related issues, as identified by CIDP (2023-2027), included inadequate general administration, policy and support services capacity; inadequate access to quality preventive and promotive health; inadequate access capacity to quality curative and rehabilitative health services. Other issues include inadequate access to safe water and inadequate sanitation coverage.

3.4 Overview of Water Coverage in Target Study Site

The water access coverage in Kisumu County was estimated at 58% and was projected to be increased to 68% by 2022. This was the projection according to the CIDP-II (2018-2022). In the same document, Nyakach water coverage was estimated at 47%, Nyando at 45% and Seme at 42%. It was noteworthy that daily water deficit for each of the three selected sub-counties was more than 1,000 cubic meters. As well, the Ward listed to have the least access to improved water service was Nyakach West, with estimated access of about 22%, while Nyando had the highest daily water deficit of about 4,885 cubic meters.

3.5 Implications of Demographic Changes and Implication of Water Service

The promulgation of the Kenya's new constitution in 2010 established the national and devolved governments. The constitution established devolved government referred to as counties. Though the 2009 Census was undertaken during the old constitutional dispensation; it is important to report difficulty for accurately comparing the demographic changes in the sub-counties that were established after 2013. For example, Nyando and Nyakach were administered as Nyando District, while Seme was part of Kisumu West District.

However, according to Kenya Population and Housing Census (2019), the population in Kisumu County was 1,555,574 people, and disaggregated by gender into 594,609 females and 560,942

ST. PAUL'S UNIVERSITY

females. Nyakach Sub County recorded a population of 150,320 people, disaggregated into 79,082 females and 71,237 males; with 35,553 households and a household size of 4.2. Nyando Sub-County has a population of 161,508 which is represented by 84,380 females and 77,121 males; with 38,460 households and a household size of 4.2. Seme Sub-County had population 144,900 people, disaggregated into 76,093 females and 68,814 males; with 29,404 households and a household size of 4.1 people.

While the KBNS Census of 2019 provided these figures, the County Government of Kisumu projections put the population's increase at 30% for Nyakach Sub-County, 25% for Nyando Sub-County and 28% for Seme Sub-County. Coupled with the already documented water deficits in these sub-counties, the increased populations are likely to put much more pressure on the existing water service provision. Both the County Government and other partners in water service provision must strengthen their efforts beyond these projections to improve the access coverage.

ST. PAUL'S UNIVERSITY

3.6 Community-Based Water Organizations

3.6.1 Water Management Models in Kisumu County

The management of borehole water service provisions in Kisumu was undertaken through various models of governance. These included those that were managed through the companies (private or otherwise), professionally managed (a professional is hired to manage for an institution), managed through the committees of the schools or health facilities. The other models included the privately operated boreholes and the community-management through the water user associations (WUAs). The WUAs are registered or not registered associations, referred to as community-based organizations (CBOs) involved in management of specific community-managed borehole. From the data generated from the County Water Offices, Table 3.1 summarizes the number of water boreholes managed through the different models within each of the selected sub-counties.

Table 3.1: Models of Water Borehole Management within Selected Sub-Counties

Water Management Models	Nyakach Sub-County	Nyando Sub-County	Seme Sub-County	Total
Company managed	1	2	2	**5**
Professional manager	0	1	0	**1**
Health facility managed	0	5	1	**6**
Private operator	0	2	0	**2**
School Board of Management	1	18	4	**23**
Water User Associations (WUA)	35	38	59	**132**
Total	**37**	**66**	**66**	**169**

On further analysis of the data presented on the Table 3.1, it was established that 78% of the community-managed boreholes was done through CBO structures referred ass the WUAs. As observed by other authors, the strategies on WUAs provide flexibility of the rules and regulations for adjustments (Engler et al., 2021). These authors also acknowledged that the possible challenges of WUAs to include the size of WUAs and community homogeneity that has implication of the voting or non-voting patterns; monitoring of the water systems through patrons or self-inspection; and implementation of effective graduated sanctions (with insufficient effective enforcement tools); and power difference between the WUA members.

3.6.2 Selection of Boreholes for the Study

In order to identify community-managed boreholes and water service points, there were purposive elimination and purposive selection. First, the targeted water systems were those that were community-managed. In this category, 132 borehole water sources were listed to be managed by water users' associations (WUAs). Applying the sampling methods used by previous researchers using the modelling methods (Ibrahim, 2017; Masduqi, 2010), nine boreholes were purposively selected from the three sub-counties, with each Sub-county having three community-managed boreholes, as distributed in Figure 3.1.

ST. PAUL'S UNIVERSITY

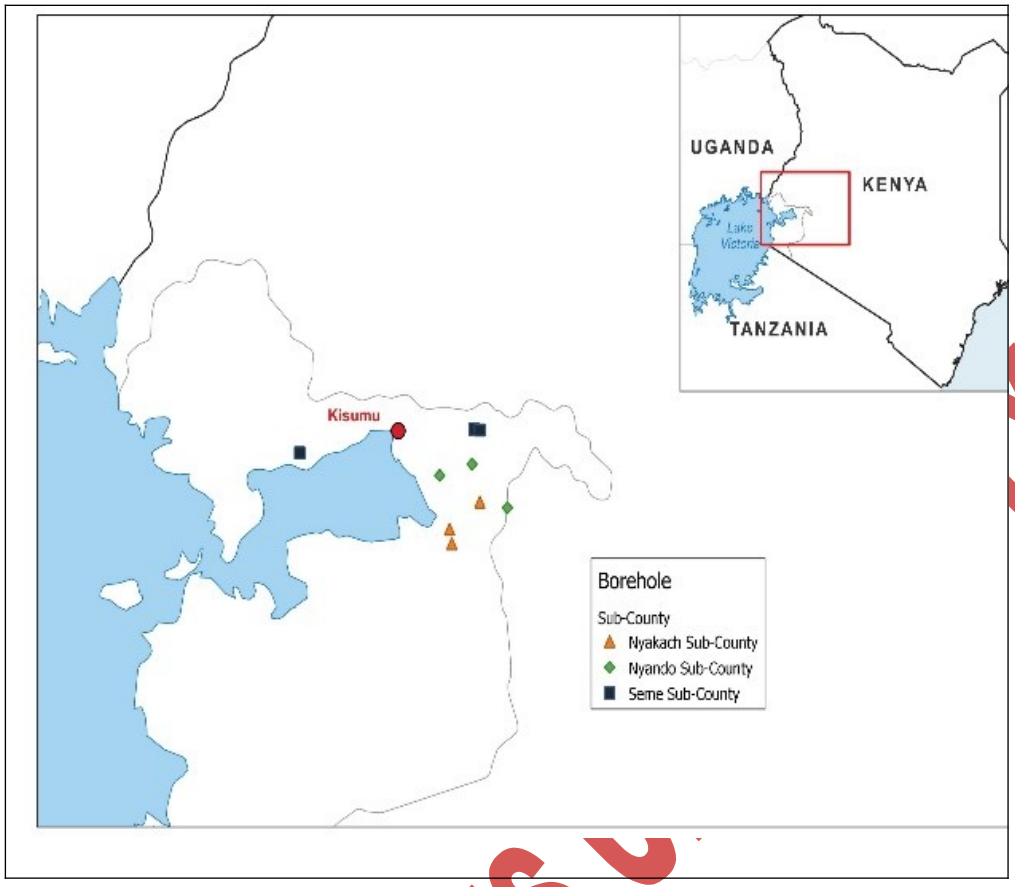


Figure 3.2: Borehole Study Sites

Each of the selected boreholes had two or more kiosks. These boreholes are described in the Table 3.1. From the data collected, majority of the respondents were from Nyakach (37.0%) followed by Nyando (34.8%) and the least being from Seme (28.2%).

Table 3.3: Selected Community-Managed Boreholes for Study

Sub county	Borehole	Remarks
Nyakach	Bolo Water project (*7 water kiosks, serving 3 villages*)	The project was implemented by Catholic Relief Services (CRS) in 2008 and metered at implementation. Population density of the area is low. There exists other water sources
	Oremo Water Project (*3 water kiosks, serving 3 villages*)	The project was constructed by World Vision Kenya in 2017 and metered at implementation. Population density of the area is low. There exists

ST. PAUL'S

		other water sources
	Ragen Water Project (*6 water kiosks, serving 3 villages*)	The project was constructed by World Vision Kenya in 2017 and metered at implementation. Population density of the area is low. There exists other water sources
Nyando	Boya Water Project (*5 water kiosks, serving 5 villages and one vocational polytechnic*)	The water project was constructed in 2002 by SANA. Only 2 CWPs were metered by then. The rest of the CWPs were constructed in 2005 and metered. Water vendors are dominant. It is estimated that handcarts carrying 12no 20lits jerricans work at least 2 trips per day
	Olasi Water Project (*5 water kiosks, serving 6 villages and one health centre*)	The borehole and the entire implementation was conducted by CGK on the FY 2016-17. Population density of the area is low. There exists other water sources
	Withur Water project – Now in Kadibo Sub County (*4 water kiosks, serving 2 villages*)	The borehole was drilled by WSTF in 2013. Kiosks were constructed in 2016 and metered at implementation. Population density of the area is low. There exists other water sources
Seme	Alwala Water Project (*one water kiosks and school point, one village and one school*)	The project was constructed in the year 2015 to serve the school; and the kiosk was constructed in 2016 and metered to serve community. Perceived unsafe water points exist nearby. Project lacks funds for expansion.
	Korwenje Market Water Project (*3 water kiosks, but only one serving 3 villages*)	The borehole was drilled in 2018. Expansion and kiosks constructed in 2020. Perceived unsafe water points exist nearby and some people prefer them due to distance to the kiosks.
	Kuoyo-Kaila Water Project (*3 water kiosks, serving 3 villages*)	The borehole was drilled in 2005. Expansion and kiosks constructed in 2018. Perceived unsafe water points exist nearby and some people prefer them due to distance to the kiosks.

ST. PAUL'S UNIVERSITY

(Author's Construct, 2021)

3.7 Target population

The target population for this was comprised of the households that use the borehole water from kiosks. The target population also included the water kiosk operators, attendants or salespersons responsible for the day-to-day operation of the services; the secretary or treasurers of the water committees; and the water officers. As shown in Table 3.3, it was estimated that around 3,375 households (about 14,175 people) were relying on the 9 borehole water points. In addition, the target population included more than 31 water kiosk operators, attendants or sales persons; 4 water officers; and 9 secretaries or treasurers.

Table 3.4: Sampled Site Population Dynamics

Sub-County	Population[1]	Water Cov. (%)[2]	Popn. Cover	HH Size	No. of WUA HH	No. of BH WUA	Ave. For WUA BH	Target HH Sampled BH
Nyakach	150,320	47	70,650	4.2	16,821	35	481	1,443
Nyando	161,508	45	72,679	4.2	17,305	38	455	1,365
Seme	121,667	42	51,100	4.1	12,463	66	189	567
	433,495		194,429		43,589			3.375

[*Derived from:* KNBS 2019 Census & Kisumu CIDP-II (2018-22)]

3.8 Sampling, Sample Size and Sampling Frame

The sample frame for this study was identified with the help of County Water Officer who was knowledgeable about the list of beneficiaries of community-based organizations providing water service through the water kiosks in the target area. The sample size was comprised of 460 households selected from the target of 3,367 households. The sample size was arrived at using the Morgan and Krenje (1970) formula. Stratified random sampling was used to select sample size from each of the sub-counties, proportional to borehole and water kiosk estimated users. The sampled households participated in the completion of study questionnaires.

[1] The population figure, household size and number of households per sub-county are derived from the KNBS 2019 Household Population and Health Census

[2] Water coverage at Sub-County and number of boreholes managed through water user associations are derived from the documents from the County Government of Kisumu, especially CIDP-II (2018-22).

ST. PAUL'S UNIVERSITY

Purposive sampling was used to select a total population of 31 participants for data collection using the FGDs and 3 participants for the KII. There were 3 FGDs conducted, one in every Sub-County. In Nyakach Sub County, the FGDs comprised of water kiosk operators and attendants, disaggregated to 5 females and 6 males. In Nyando Sub County, the FGD participants were comprised of 6 females and males described as operators, attendants or salesperson. In Seme Sub County, the FGD participants comprised of 4 females and 4 males. The participants were between the ages of 22 years and about 57 years. The criterion for inclusion were that one must be attached as an operator, attendant or a salesperson at a borehole water kiosk, reporting to a water users' committee. As well, the exclusion included those who might have been hired less than six months before the time of data collection.

Three KII participants were purposively selected. One was the County Water Officer responsible for coordinating the WASH Network within the Kisumu County. The other was the secretary of the water committee from one of the sampled boreholes within Seme Sub County, while the other was the treasure for the water committee of the sampled borehole within the Nyando Sub-County.

3.9 Data Collection and Analysis

The researcher collected and analysed both quantitative and qualitative data. Five researcher assistants assisted in the data collection.

3.9.1 Quantitative Data Collection and Analysis

The researcher used a questionnaire with closed-ended survey questions. The questionnaires were organized into five sections. The first section was comprised of participants' socio-economic and socio-demographic questions. Section two was comprised of survey questions on the technical designs of the water boreholes and kiosk, piping and layouts. Section 3 was comprised of survey questions on water governance by the Water committees. Section 4 was comprised of questions around the household use characteristics and patterns. Finally, Section 5 was comprised of questions on the financial sustainability. The questionnaire was administered

ST. PAUL'S UNIVERSITY

face-to-face with research assistants completing the questionnaire according to participants' responses.

3.9.2 Operationalization and Measurement of Study Variables

Financial sustainability of borehole water kiosk services was the dependent variable. The study described the perceived ability of the water kiosk to generate enough revenue to cover its operational and maintenance costs in a sustainable way. This variable was computed as a binary variable (1 = High vs. 0 = Low) based on six survey questions that provided insight on user fees, tariff structure, community ownership, perceived ease of kiosk maintenance and revenue collection. This financial sustainability index was constructed using principal component analysis (PCA), with three principal components explaining 64.9% of total variation. The index was then standardized using z-score and values above zero were considered to correspond to high financial sustainability and hence coded as 1 while those below zero were considered low financial sustainability and hence coded as 0.

User household characteristics: This variable describes various demographic, socio-economic, and behavioral traits of the households who utilize the services provided by the borehole water kiosk. It included main source of drinking water, frequency of fetching water from the borehole kiosks, satisfaction with the borehole kiosk as a source of drinking water, duration (in minutes) it took to fetch water, and seasonality of household use of borehole water. Six items on the frequency of using borehole kiosk water in different seasons were used to construct the seasonality index, with a reliability of 0.82 based on Cronbach's alpha and two principal components explaining 80.6% of total variance. The seasonality index of household use was standardized using z-scores and values above zero were considered high usability and hence coded as 1 while those below zero were to have low usability index and hence coded as 0.

User households' sense of ownership: This is a set of independent variables that described individual user's direct contributions through payment of membership and perception on community ownership of drinking water system.

ST. PAUL'S UNIVERSITY

Technical design and layout of water kiosks: This variable described a set of technical factors related to borehole water kiosk such as water pressure, year of establishment, reliability of service point, functional state, and presence/absence of water technicians.

Household Perceptions of Governance on efficacy of Borehole and Water Kiosks Committee on the influence of financial sustainability of borehole water kiosks. This variable was operationalized through questions such as whether there was presence or absence of water committee; household awareness of someone serving in the committee; frequency of their meeting with the water kiosk users; their function being management of the water system; presence or absence of schedule for opening and closing of the water kiosk; absence or presence of water kiosk operator; and satisfaction of water users on where the borehole water kiosk was located.

Household Involvement and Participation in governance of the water kiosks was operationalized in the survey questions as whether someone from the said household was involved in the water supply management or water committee; attendance or non-attendance of the previous committee meeting with the water users; and whether the household contributed towards the establishment of the water kiosk.

Moderating variable was operationalized by questions around the geographical locations of the user households' residence; ownership of land where the borehole or the water kiosks were located.

ST. PAUL'S UNIVERSITY

3.9.3 Computing Household Socio-Economic Status

The construction of the household socio-economic status (SES) was constructed as a composite of variables from a list of household assets and other indicators of well-being. These indicators of wellbeing included the electricity, type of roofing and wall, water sources, household amenities. The household assets were collected in form of dichotomous response in which the household responded on presence or absence. The principal component analysis (PCA) was used to compute SES into ordinal variable of either poorest, poor or least poor. The SES was then

standardized by computing the z-scores, to obtain a normally distributed score. The quintile technique was then used to divide a dataset into 3 equal groups based on ranking of the standardized SES values. These groups represented clusters of households with similar wealth profile.

3.9.4 Descriptive Statistical Analysis and Quantitative Data

Data analysis was conducted following the objectives of the study. Results of each objective were conducted first by presenting descriptive analysis of each independent variable. The first level of analysis presents the cross-tabulation between each independent variable and the dependent variable (financial sustainability of borehole water kiosk services) with additional columns showing overall percentage for univariate outcome of each variable and a Pearson's chi-square p-value of statistical significance. The second level of analysis which is multivariate level presents the binary logistic regression analysis followed by marginal effects model.

3.9.5 Description of Logistic Regression

Binary Logistic regression was used to assess the statistical significance of the each of the following independent variables (IVs) on the outcome variable. The IVs included the household borehole water kiosk service user characteristics; user households' sense of ownership of a borehole water kiosk; borehole kiosk technical designing, piping and layout factors; the user households' perception on the water kiosk governance by the water committees; user households' involvement and participation in borehole and water kiosks' governance.

Logistic regression is a regression model where the dependent variable is categorical in nature. The logistic function is used to predict the probability of membership into a given category based on a set of independent variables. The independent variables can take a different measurement scale. There are three types of logistic regression models depending on the number of values the dependent variable can take. In the binary logistic regression, the dependent variable takes only two possible outcomes such as "Yes-No"; "Low-High", among others. Multinomial regression is a model used when the dependent variable has three or more possible outcomes such as "Green-Blue-White". The output values in a multinomial regression do not appear in any specific order.

ST. PAUL'S UNIVERSITY

Ordinal logistic regression is a model used when the dependent variable has three or more possible outcomes as "Strongly Agree-Agree-Disagree". The output values in an ordinal variable logistic regression model have a connotation of ordering in that the responses are ordered.

In this study, binary logistic regression model was adopted as the dependent variable (financial sustainability) had only two possible outcomes. Financial sustainability was defined in two ways based on the specific perceived financial conditions of the community-managed borehole water kiosk. First, the financial sustainability condition of the community-managed borehole water kiosk could be considered low depending on whether the user households paid to access the water at the kiosk and whether such payments were sufficient to meet the recurrent running costs of the borehole water kiosk service. Second, the financial sustainability condition of the community-managed borehole water kiosk could be considered high depending on when the user households paid to access the water at the kiosks and such payments were sufficient to meet the recurrent running costs of, with some reserved for future eventuality at, the borehole water kiosk service.

In order to model the binary logistic regression for the financial sustainability Y (0 or 1), E(Y) = P(Y=1), the dependent variable Y is transformed into a logit form which describes the probability of the presence of the character on interest. In this study, it was considered to be high financial sustainability. Thus,

$$logit(p) = \beta o + \beta iXi$$

Where; $logit(p) = \ln\left(\frac{p}{1-p}\right)$, which is a log of the odds for success; and βiXi describes a linear combination of a set of user households' characteristics, technical designs and governance factors used as drivers of the financial sustainability.

ST. PAUL'S UNIVERSITY

The logistic regression model was used as analytical model for the objective areas on determining the significant influencers of financial sustainability. In assessing the significance of user household characteristics influencing the financial sustainability of community-managed borehole water kiosk services in Kisumu County, a question was posed on whether the user households' characteristics had any significant influence on the financial sustainability. The most appropriate cut-off level of p=0.05 was used (Meyer et al., 2017). Other studies noted advances in statistical practice and methodologies that report p-values (particularly p = 0.10, p = 0.05, and p = 0.01) with respect to the p = 0.05 benchmark while indicating the significant estimates with *, ** or *** (Meyer et al., 2017). In this study, the confidence levels of logistic regressions were evaluated at 95% (p = 0.05) or 90% (p = 0.10) depending on the nature of association presented by the p-value. If the < 0.05 , then reject the null hypothesis with the βi in the logistic model.

In assessing the significance of borehole water technical design and layout influencing the financial sustainability of community-managed borehole water kiosk services in Kisumu County, a question was posed on whether the borehole water technical design and layout factors had influence on the financial sustainability. The most appropriate cut-off level of p=0.05 was used and as noted in advances in statistical practice and methodologies that report p-values (particularly p = 0.10, p = 0.05, and p = 0.01) with respect to the p = 0.05 benchmark while indicating the significant estimates with *, ** or ***. As well, the confidence levels of logistic regressions were evaluated at 95% (p = 0.05) or 90% (p = 0.10) depending on the nature of association presented by the p-value. If the < 0.05 , then reject the null hypothesis with the βi in the logistic model.

Finally, in assessing the significance of borehole water governance factors influencing the financial sustainability of community-managed borehole water kiosk services in Kisumu County, a question was raised on whether the borehole water technical design and layout had influence on the financial sustainability. The most appropriate cut-off level of p=0.05 was used and as noted in advances in statistical practice and methodologies that report p-values (particularly p = 0.10, p = 0.05, and p = 0.01) with respect to the p = 0.05 benchmark while indicating the

ST. PAUL'S UNIVERSITY

significant estimates with *, ** or ***. As well, the confidence levels of logistic regressions were evaluated at 95% (p = 0.05) or 90% (p = 0.10) depending on the nature of association presented by the p-value. If the < 0.05 , then reject the null hypothesis with the βi in the logistic model.

3.9.5 Reliability and Validity

3.9.5.1 Reliability and Validity Tests for Quantitative Data

Before the start of the field community mobilization and data collection, the study instruments were pretested and revised to check if the questions captured what there were meant to measure. The questionnaire was pre-tested using 62 user households of kiosk water services in Rabuor Community Water Project within Kisumu County. The user households who participated in the pretest were identified through simple random sampling and the site was excluded from the main household survey. The collected data from the pretest was analyzed for validity and reliability, resulting in a Cronbach's alpha result of about 0.72. Some previous studies have shown that Cronbach's alpha of at least 0.70 and above indicates a satisfactory level of reliability (Bonett & Wright, 2015). A few actions were taken based on the individual item's content and construct validity. For instance, the initial questions had with some open-ended questions that gave respondents rooms for diverse opinions and seemed like interviews. These were re-framed to provide options for selections by the respondents. As well, the questionnaire seemed to have some many questions, some of which to have been repetition. These were removed and one such question sharpened to capture the necessary information. The researcher adjusted the questionnaire to fit in and include these aspects after the pilot.

3.9.5.2 Reliability Test for for Qualitative Data

The reliability of qualitative research was concerned with the repeatability, stability and consistency of the participants' responses and the ability of the researcher to collect and record information accurately. The validity, on the hand, had to do with the truthfulness and accuracy of the findings of the research. Thus, according to Brink (1993), the results should represent the reality of the participant while this reality is being representative across the participants. During

ST. PAUL'S UNIVERSITY

the in-depth interviews with key informants, the researcher exercises self-reflexivity through setting aside pre-understanding and acted non-judgemental (bracketing) from own opinions, assumptions and or experiences about the subject matters to ensure the voices of the participants were heard. The self-reflexivity was to guide the relation of the researcher's experience with the topic of discussions, expectations from the discussion and relationships with the participants, especially with regards to the ethical concerns and power differentials (Gilgun, 2014). Once the initial codes of the data analysis were developed, the researcher exhaustively discussed the details of these initial codes with one of the advisors and other experts in qualitative data analysis. This was done before the full coding process was undertaken. Thick description from texts was used to fully represent the participants' multiple realities through support of different dimensions and interpretations found in the research (Gilgun, 2014). Finally, the researcher shared some the transcripts with the participants for their reactions and feedback as to whether the information they had provided was fully captured.

3.9.6 Qualitative Data Collection and Analysis Methods

3.9.6.1 Key Informant Interview Tool

In examining the perceptions of the water officers and committee members on the financial sustainability of the community-managed water kiosks, the researcher conducted in-depth interviews with purposively selected county water officer in charge of coordination of water supporters within the county, one water committee secretary and another committee treasurer.
The information gathered from the water officer included the implementation policy and legal frameworks for the water boreholes water services within respective jurisdictions, appropriate technology, design and layout of the borehole, the maintenance of quality, enforcement of management and functionality of water service systems. At the beginning of each KII, the purpose of the study was explained, assurance of confidentiality given, and the consent to participate was sought from the participants. For the secretary or treasurer, the information revolved around frequency of meetings; training of operators; corporation with other agencies;

ST. PAUL'S UNIVERSITY

budgeting, record and book-keeping, savings and spending policies. Other information regarded the costs of construction and future plans for the borehole expansion or otherwise.

3.9.6.2 Focus Group Discussion Interview Tool

The FGD tool was comprised of open-ended questions with the community-managed borehole water kiosk operators. The FGD questions were categorized into three components, including the financial sustainability; user households' characteristics; technical designs and layout; and governance by the water committees. The technical design issues that were being probed included the water kiosk siting, layout of systems, and water collection point designs. In the governance of the water kiosks by the committees, issues probed included decisions of the committees on the amounts charged, composition of the committees disaggregated by the gender, representation, local political experiences, appointments and remuneration of the kiosk operators and plumbers, schedule of opening and closing the kiosks. For the household water use characteristics, the issues probed included seasonal variation in fetching water from the kiosk, payment patterns, container types and sizes they use. Finally, financial sustainability issues probed included the daily payment collections and use, saving and spending, sales and record keeping, among others. The tools used are presented in Appendix 1.

3.9.6.3 Transcription and Analysis of Qualitative Data

Data from KII and Focus Group Discussions was first transcribed verbatim into the readable texts (MS Word) by a specialist and cross checked by the researcher. This was to ensure that the information from the audio recording had been captured in the text transcript. The transcripts that had been recorded in Dholuo were translated into English by an English-Dholuo linguist. Further, this translation was cross-checked. This was followed by qualitative thematic analysis. The FGD and KII data (from the notes and audio transcripts) were analyzed manually. This involved the preparation and organizing the data; reviewing and exploring the data; creating initial codes; reviewing and creating themes; and presenting the themes and findings in a coherent manner.

ST. PAUL'S UNIVERSITY

In the preparation and organization of data, all the materials relevant to the FGDs, which included the transcribed and translated audio, two different notes that were taken during the FGD and the observation report were harmonized. The FGD had two note takers both male and female for the purposes of comparison and to supplement the transcribed audio. They had been captured in different word documents. Data coding was done in excel for easier tracking of codes and themes. Thus, the transcripts were imported into an excel file before data analysis started.

In the reviews and exploration of data, before the actual analysis of the data began, all the available data was read through. Materials, in regard to the FGDs, including the transcripts, notes, observation report, and the data collection tool used to collect the data were reviewed. This process was continuous as one might have been needed to read through the data continuously so as to get a sense of the data before the coding process began. As the process of going through was on, notes about any thoughts, ideas, excerpts or observations were taken down from the data that would be helpful during coding. This resulted in the initial codebook.

Data coding was done in thematic framework and during the initial coding process, the data produced a magnitude of codes from the transcripts. For the reliability, once the first initial codes were generated, one page of transcript from which such codes were generated and shared with two other persons knowledgeable in qualitative data analysis to also generate the codes. There were about 70-80% similarities on these undertakings. This initial coding was also supported by the notes taken during data collection and the observation report. Each code had an excerpt from the transcribed audio supporting its existence in the data. Therefore, under each code, there existed an excerpt which was assigned to it from the data. The excerpts were highlighted in bold from the rest of the passage for easier scheming through. Some of the initial codes generated include different roles and responsibilities; community involvement; skills and expertise; proper communication; operating procedures (problem-solving), sustainable materials and proper workmanship. Others included involvement of other partners; water conservation; water availability; local administration involvement; availability of spare parts; bad workmanship; salty or contaminated water; blocked pipes; water vandalism; and incidences of drought. Once initial codes were generated, they were reviewed, revised and combined in themes. This process

ST. PAUL'S UNIVERSITY

involved identifying recurring codes, language, opinions, and beliefs. These were then merged to form distinct themes in regard to community-managed water boreholes kiosks. These themes were further broken down into sub-theme categories of sustainability. Finally, presentation of themes and findings were made in a cohesive manner. The findings were narrated in a manner to tell the story of the data, considering the research project objectives and questions. Therefore, the relevant contents and excerpts from the data to support the findings and also help tell the story better were included. The narrative report was done in a word document.

3.9.7 Ethical Issues and Approvals

The necessary licenses, permits and approvals for undertaking research in Kenya were sought and gotten. For example, the researcher obtained the research license from the National Commission for Science, Technology and Innovation (NACOSTI). Permission to collect data was also obtained from the Kisumu County Commissioner and County Director of Education. As well, permission was granted by the Department of Water of the County Government of Kisumu. During the actual data collection, the researcher explained the purpose of the research and content of the document of consent of the participants and respondents before the data collection process was started. The participants and respondents were informed in advance that responding to the questions and the research was voluntary and any participant or respondent had a right to withdraw at any, if (s)he wanted to stop his or her earlier consent. The consent of letter explained the general and specific objectives of the research. These explanations created the necessary environment for developing rapport with the respondents. The researcher ensured that the respondents voluntarily appended their signatures on the consent letter.

ST. PAUL'S UNIVERSITY

Another ethical consideration involved was assuring the participants and respondents of confidentiality of the data provided by the respondents either through interviews and discussions recordings or the questionnaires. The data collected was not disclosed to other respondents or to other individuals. Consequently, the data collected and used for writing this thesis were collected

from the respondents and participants but were not attributed to any specific participant. The data were analyzed using identification codes to ensure anonymity.

3.8 Chapter Summary

The overriding concern of this chapter was to set out the methodological details fitting this study. It gave the gradual development of various philosophical paradigms for community development namely; the positivist tradition, interpretivism, the transformative paradigm and pragmatism. Of all these paradigms, the pragmatic paradigm was the most suitable in the application of the mixed-methods approach adopted in this inquiry. The research targeted households that use the borehole water, borehole water kiosk operators, attendants responsible for the day-to-day operation of the borehole services, treasurers of water committees and water officers in Nyakach, Nyando and Seme Sub-counties of Kisumu County. The researcher applied stratified sampling to choose 460 households forming the quantitative sample and purposive sampling to select the 31 respondents working as operators, attendants or salespeople at a borehole water kiosk and reporting to a water users' committee for at least six months. Quantitative data from this sample was obtained using questionnaires which had closed-ended items while qualitative data was gathered through key informant interviews and focus group discussions. The questionnaires probed participants' socio-economic and socio-demographic characteristics, technical designs of boreholes and kiosks, piping and layouts, water governance by the water committees, household use characteristics and patterns and the financial sustainability. The key informant interviews involved purposively selected county water officers in charge of coordination of water supporters within the county, one water committee secretary and another committee treasurer. The focus group discussions involved open-ended items that targeted the community-managed borehole water kiosk operators. These items inquired on financial sustainability, user households' characteristics, technical designs and layout and governance by the water committees. Furthermore, the chapter demonstrates the transcription, translation and analysis of the data gathered and general maintenance of validity are reliability handling of procedures. A specialist generated a Microsoft Word text transcript of the audio recordings of the qualitative data, while a linguist translated Dholuo text transcripts into English. The final part of the chapter outlines

ST. PAUL'S UNIVERSITY

various ethical issues taken into account in the study, such as seeking approval from NACOSTI, Kisumu County Commissioner and County Director of Education and the Department of Water of the County Government of Kisumu. The same section elaborates how the researcher ensured that participation by respondents was voluntary and assured them of confidentiality and anonymity of the data they gave. The next chapter uncovers the interpretation of the analyzed data.

ST. PAUL'S UNIVERSITY

CHAPTER FOUR

STUDY RESULTS AND INTERPRETATIONS

4.1 Chapter Introduction

This chapter explores the findings obtained from this systematic investigation. The preliminary findings that it presents unveil the socio-economic and socio-demographic characteristics of the sample involved in the study. Ensuing these are findings on household fetching of water and years of establishment of the boreholes and water kiosks under scrutiny. The succeeding subsections set forth various results based on the specific objectives of this study. These are households' characteristics, user household sense of ownership, technical factors, perception on water committees, participation of the user households and other moderating factors. The findings of these objectives are reported in the following order; the first part presents the descriptive statistics, then the next subsection displays the results of the cross-tabulations while the ultimate part reports the findings from the binary logistic regression. The findings from the qualitative data are integrated within or after the results from the quantitative statistical analyses.

ST. PAUL'S UNIVERSITY

4.2 Demographic Information of Respondents

Majority of the household heads who responded to the questionnaires were men. The mean age of the household head was shown to be 49 years (± 14 years) with the minimum head being 22 years while maximum being 87 years old. The average number of children between 0-18 years in the household was found to be 2 children (SD=±1) with the median and mode being 2.00 children. As well, households with the highest number of children had maximum of 7 children. The average number of children below the age of 5 years was found to be one child per household with the median and the mode being 0.0. As well, the households with the highest number had a maximum of 7 children.

The main household members' occupations were found to be farming, business and self-employment, accounting for over 72%. The proportion of the households involved in fishery

activities was revealed to be 2%. This finding on the fishery activity was surprising as a number the households were close to Lake Victoria. Table 4.1 presents the socio-demographic characteristics of the sample.

Table 4.1: Basic Socio-Demographic Characteristics

Characteristics	Frequency	Percent
What is the gender of head of household?		
Female	194	42.2%
Male	266	57.8%
What is the estimated age of the head of the household?		Mean = 49 Mode = 48 years
What is the highest education level of the head of household completed?		
No school	25	5.4%
Primary level	178	38.7%
Secondary level	152	33.0%
College (artisan, certificate, diploma)	81	17.6%
University (Bachelors, Masters, PhD)	24	5.2%
How many people in TOTAL, including you, currently live in the household?		Mean = 2 Mode = 2 people
How many children are 0 to 18 years in this household?		Mean = 3 Mode = 2 children
What is the main occupation of the head of household?		
Farming	177	38.5%
Business	104	22.6%
Fisher-folk	9	2.0%
Employed	43	9.3%
Daily Labour	35	7.6%
Self-employed	51	11.1%
House wife/husband	41	8.9%
Wealth Status		
Poorest	158	34.3%
Poor	148	32.2%
Least poor	154	33.5%

(Source: Author's Survey Data, 2022)

ST. PAUL'S UNIVERSITY

4.3 Households Fetching of Water for Domestic Use

The study revealed that about 79% of households acknowledged paying to fetch their water from kiosks. The sufficiency of the amount charged in running the kiosks was reported by slightly less than 58% of the households. Majority of the households (89%) used plastic jerricans (20-litres),

making at least two trips in a day. About 65% of the households reported that they used the same containers used to transport the water to store it at home. As shown in Table 4.2, these findings and others have been provided.

Table 4.2: Household Drinking Water Practices

Characteristics	Frequency	Percent
Do you pay to collect your water from the kiosk?		
No	97	21.1%
Yes	363	78.9%
Is the amount charged sufficient for running of the water kiosks?		
No	196	42.6%
Yes	264	57.4%
What kind of containers do you use to fetch and transport water from the Borehole water kiosk?		
Plastic jerricans (20-litre)	410	89.1%
Plastic jerricans (10-litre)	23	5.0%
Plastic bucket with large opening	23	5.0%
Clay pot	4	0.9%
Do you use the same container for water transport and water storage?		
No	162	32.2%
Yes	298	64.8%
What kind of containers do you use to store the drinking water?		
Clay pot	201	43.7%
Small container with a tap	35	7.6%
Small container without a tap	71	15.4%
Large container with a tap	48	10.4%
Large container without a tap	105	22.8%
How many trips did you make to the water source yesterday?		Mean = 2 trips Mode = 0
Was the water you collected yesterday sufficient for your household need?		
No	135	29.3%
Kind off	233	50.7%
Yes	92	20.0%
Yesterday, can you tell me how many times you fetched water from the kiosk?		Mean = 2 times Mode = 0
How satisfied are you with your kiosk as drinking water source kiosk?		
Dissatisfied	49	10.7%
Satisfied	411	89.3%

(Field Results, 2022)

ST. PAUL'S UNIVERSITY

4.4 Year of Establishment of Boreholes and Water Kiosks

The nine sampled boreholes were categorized into three major time frames. Those established from 2017-2022 were described as recently established. Those established from 2009-2016 as moderately old boreholes while those established from 2001-2008 were described as old establishments. From analysis, majority of households (about 50%) described the water boreholes as being recently established. When the households were asked on their awareness of whether the borehole-water kiosks were established at the same time, about two thirds (66.0%) of households reported that a number of boreholes and associated kiosks were not established at the same time.

The analysis on water kiosk infrastructure years of establishments, with a similar time frame of categorization as for the boreholes, was undertaken. The findings established that majority (42.2%) of households described the water kiosks as recently established (2017-2022). These findings were triangulated from the secondary documents and those from FGDs, which similarly indicated the boreholes and extended water kiosks from such boreholes were established at different time frames. Thus, a proportion of borehole water kiosks from old establishments were later structured as extensions and establishments. Table 4.3 and Figure 4.1 illustrate these findings.

Table 4.3: User Households Description of Years of Boreholes and Kiosks Establishments

Characteristics	Frequency	Percent
Year when the Borehole was established?		
Recently established boreholes (2017-2022)	229	49.8%
Moderately old established boreholes (2009-2016)	63	13.7%
Old borehole establishments (2001-2008)	168	36.5%
Year when kiosk was established?		
Recently established boreholes (2017-2022)	194	42.2%
Moderately old established boreholes (2009-2016)	126	27.4%
Old borehole establishments (2001-2008)	140	30.4%

(Field Results, 2022)

ST. PAUL'S UNIVERSITY

The findings from a majority of the water boreholes and kiosks within the study area could be interpreted to be the impact of the increased investments of the current County Government of Kisumu and other development partners' increased spending and expansion of community water facilities.

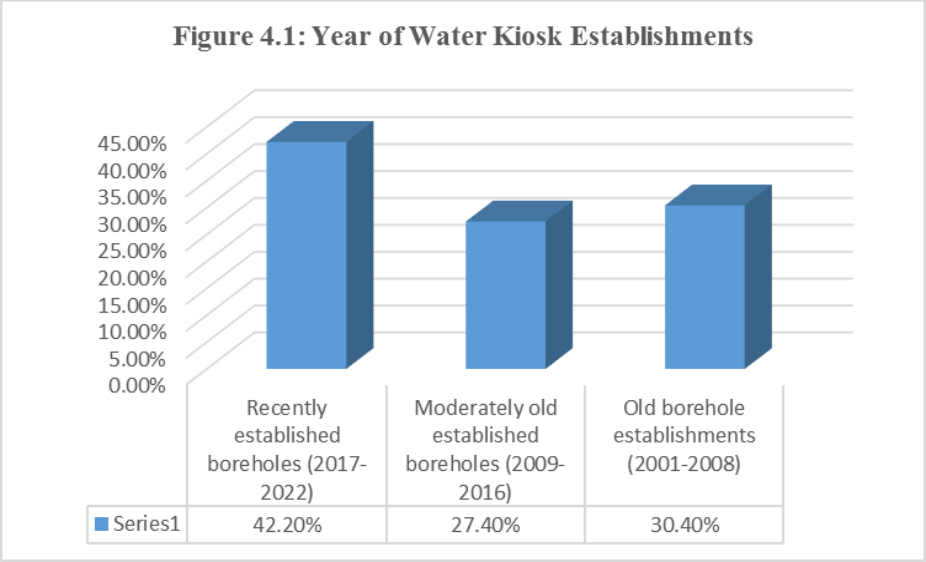


Figure 4.3: Year of Water Kiosk Establishment

(Field Results, 2022)

ST. PAUL'S UNIVERSITY

4.5 Influence of User Households' Characteristics on Financial Sustainability

The first objective sought to analyze the influence of water kiosk user household characteristics on financial sustainability of borehole water kiosk services. In this regard, it sought to establish the main sources of household drinking water; the frequency of collecting water from the borehole water kiosk; and the seasonality of use (in dry or rainy seasons) on water kiosk services. The uses included drinking, bathing, cleaning and washing.

4.5.1 Households Main Sources of Water for Domestic Use and Drinking

When the households were asked what their main drinking water sources were, they shared various options. The results showed that majority of the (more than 74%) households got their main drinking water from the borehole water kiosks followed by open sources (dam, pan, river,

lake). The least preferred source of water was vendor or bottled water at 0.2%. It was shown that around 62% of the households always fetched their water from the borehole water kiosks, as shown in Table 4.4.

Table 4.4: Household Borehole Water Kiosk Use Patterns

Characteristics	Frequency	Percent
What is the source of your main drinking water?		
Tap (in public/private plot)	34	7.4%
Borehole water kiosk (public)	342	74.3%
Hand pump (private/pub	10	2.2%
Spring (protected/unprotected)	4	0.9%
Open (dam, river, river, lake)	36	7.8%
Vendor/Bottled	1	0.2%
Harvested rain water	33	7.2%
How often did you fetch your water from the borehole kiosk as the main source?		
Never	44	9.6%
Half the times	130	28.6%
Always	281	61.8%
Rank how committed you are to always fetch your water from the water kiosk all year long?		
Not at all committed	35	7.6%
Rather committed	303	65.9%
Very committed	122	28.5%

(Field Results, 2022)

The finding showed that almost two-thirds of the households always fetched their water from the borehole water kiosks as their main source. However, the 29% who fetched water only half the times and about 10% who never fetched water from the water kiosks showed a likely fluctuation of incomes to the water kiosks. It is also important to note that two thirds of the households responded that they were only rather committed to fetching their water from the water kiosks all year long.

ST. PAUL'S UNIVERSITY

4.5.2 Household Seasonal Use of Borehole Water Kiosk Services

This section assessed the household seasonal use of borehole kiosk water during rainy and dry seasons. The questions on the seasonality of use sought on variables such as the sources, reasons for use of that source, frequency and time taken for a round-trip to collect water. The study showed that over 35% of the households did consider the frequency of fetching water during

rainy seasons (not applicable for these households) for drinking, bathing, cleaning and washing. However, the proportion of households who considered frequency of fetching water was reduced to 7% or less during dry seasons. The households that considered the frequency not applicable were those who had water within their compounds. Furthermore, while only around 48% of households made up-to two trips daily to fetch their water from their preferred source during rainy seasons, 65% to 73% made up-to two trips daily to fetch their water from preferred source during dry seasons, depending on the use.

Table 4.5: Household Borehole Water Kiosk Seasonal Use Patterns

Characteristics	Frequency	Percent
Rainy Seasons		
How often do you go to this water source during rainy season to collect the water for drinking purpose?		
Not applicable	180	39.1%
Once per daily	138	30.0%
Twice per daily	84	18.3%
Thrice per daily	31	6.7%
More than thrice per daily	27	5.9%
How often do you go to this water source during rainy season to collect the water for cleaning and washing purpose?		
Not applicable	169	36.7%
Once per daily	119	25.9%
Twice per daily	97	21.1%
Thrice per daily	44	9.6%
More than thrice per daily	31	6.7%
How often do you go to this water source during rainy season to collect the water for bathing purpose?		
Not applicable	164	39.1%
Once per daily	142	30.0%
Twice per daily	101	18.3%
Thrice per daily	31	6.7%
More than thrice per daily	21	5.9%
Dry Seasons		
How often do you go to this water source during dry season to collect the water for drinking purpose?		
Not applicable	31	7.0%
Once per daily	180	39.1%
Twice per daily	155	33.7%
Thrice per daily	59	12.8%
More than thrice per daily	35	7.6%
How often do you go to this water source during dry season to collect the water for cleaning and washing purpose?		
Not applicable	32	7.0%
Once per daily	116	25.2%
Twice per daily	187	40.7%

ST. PAUL'S UNIVERSITY

Thrice per daily	61	13.3%
More than thrice per daily	64	13.9%
How often do you go to this water source during dry season to collect the water for bathing purpose?		
Not applicable	31	6.7%
Once per daily	181	38.3%
Twice per daily	155	33.7%
Thrice per daily	59	12.8%
More than thrice per daily	34	7.4%
In what season do you go several times to collect water from the kiosk?		
Same across seasons	14	3.0%
Rainy seasons	4	0.9%
Dry seasons	442	96.1%

(Field Results, 2022)

Table 4.5 provides the descriptive findings of daily frequencies of the trips the households made to fetch water for different uses during rainy and dry seasons. On the other hand, Table 4.6 is a summary of findings on the household daily frequencies to select water sources and the reasons for the households choosing those water sources for seasonal water use.

Table 4.6: Seasonal Water Use Reasons and Frequencies

Water Use	Rainy season	Dry season
Drinking	About 58% fetching three times a day, with reasons • Appealing colour • Source closest to the households	About 86% fetching three times a day, with reasons • The only source available. • Source closest to the households
Washing and cleaning	About 56% fetching three times a day, with reasons • Charge low amount • Source closest to the households	About 59% fetching three times a day, with reasons • The only source available. • Source closest to the households
Bathing	About 60% fetching three times a day, with reasons: • Charge low amount. • Source closest to the households	About 86% fetching three times a day, with reasons: • The only source available. • Source closest to the households

(Field Results, 2022)

ST. PAUL'S UNIVERSITY

4.5.4 Association of Household Water Use Characteristics with Financial Sustainability

Table 4.7 below presents a cross-tabulation between user characteristics and financial sustainability of water kiosk services. The overall percentage column shows the proportion of each of the response categories, which is further clustered into individual portions of low or high

financial sustainability of water kiosk services for comparative purposes. The statistical significance of the proportions is reported based on Pearson's chi-square test of association at 0.1 and 0.05 significance levels respectively. Most users (74%) rely on the borehole kiosk (public) as their primary source of drinking water, indicating its significance as a central water supply for the community. Tap water (public or private plot) and open sources (dam, pan, river, or lake) each account for 7% and 8% of users respectively, suggesting that some users may have alternative water sources. The analysis indicated that the main source of drinking water has a statistically significant relationship with the financial sustainability of water kiosk services ($\chi 2 = 0.506$, $p > 0.05$). Notably, users who primarily relied on borehole kiosk water for drinking contributed to higher financial sustainability, with 28.0% reporting high financial sustainability. In contrast, those who rely on tap water (public or private plot) and open sources (dam, pan, river, or lake) have lower proportions of high financial sustainability at 2.6% and 2.8%, respectively. These findings are provided in Table 4.7.

ST. PAUL'S UNIVERSITY

Table 4.7: Cross-Tabulation of User Characteristics and Financial Sustainability

User characteristic	Response	Overall Percentage	Financial Sustainability of water kiosk services		P-value
			Low	High	
Main source of drinking water					0.506
	Tap (public/private plot)	7%	4.8%	2.6%	
	Borehole kiosk (public)	74%	46.3%	28.0%	
	Hand pump (public/private)	2%	1.7%	0.4%	
	Spring (protected/unprotected)	1%	0.9%	0.0%	
	Dam/Pan/River/Lake	8%	5.0%	2.8%	
	Vendor/Bottled water	0%	0.2%	0.0%	
	Harvested Rainwater	7%	3.9%	3.3%	
Frequency of collecting water from borehole kiosk					0.245
	Never	10%	6.8%	2.9%	
	Half the times	29%	18.9%	9.7%	
	Always	62%	36.9%	24.8%	
Satisfaction with kiosk water for drinking					0.001
	Dissatisfied	11%	8.9%	1.7%	
	Satisfied	89%	53.9%	35.4%	
How long it takes to fetch water from borehole kiosk					0.001
	Below 10	35%	17.5%	17.2%	

St. Paul's University Repository

	10 -19	17%	10.9%	6.6%	
	20 - 29	22%	15.8%	5.8%	
	30 & above	26%	18.2%	8.0%	
Seasonality in Household Water Kiosk Use					0.001
	Low	54%	46.5%	7.8%	
	High	46%	16.3%	29.3%	

(Field Results, 2022)

A significant portion of users (62%) fetched water from the borehole kiosk always, reflecting a high demand for the kiosk's services. Approximately 29% fetched water from the kiosk half the time, indicating some variability in usage patterns. However, 10% of users never fetched water from the borehole kiosk, suggesting they may rely on other water sources or face specific circumstances. The frequency of fetching water from the borehole kiosk also showed a relationship with financial sustainability, although it was not statistically significant ($\chi2 = 0.245$, $p > 0.05$). Users who fetched water always tended to have a higher proportion of high financial sustainability at 24.8%, while those who never fetched water from the kiosk had the lowest proportion at 2.9%.

The data showed that a large majority of users (89%) were satisfied with the quality of the kiosk water for drinking. This high level of satisfaction was a positive sign for the service's sustainability. It indicated that satisfied users were likely to continue using the service and support its long-term viability. Nevertheless, it was essential to acknowledge that 11% of users expressed dissatisfaction. User satisfaction with the quality of kiosk water for drinking was strongly associated with financial sustainability, with a statistically significant relationship ($\chi2 = 0.001$, $p < 0.05$). Among users who were satisfied with the water, 35.4% report high financial sustainability, whereas only 1.7% of those who were dissatisfied contribute to high financial sustainability.

The time users take to fetch water from the borehole kiosk varies. About 35% of users could obtain water in less than 10 minutes, indicating relatively quick and convenient access to the kiosk. However, approximately 17% spend 10-19 minutes, 22% spend 20-29 minutes, and 26% spend 30 minutes or more fetching water. The time it took to fetch water also demonstrated a statistically significant relationship with financial sustainability ($\chi2 = 0.001$, $p < 0.05$). Users

ST. PAUL'S UNIVERSITY

who spent less than 10 minutes and 10-19 minutes to fetch water from the borehole kiosk contributed significantly to high financial sustainability, with proportions of 17.2% and 6.6%, respectively.

Seasonal patterns in water kiosk use were evident among users. Around 54% have low seasonality in their household water kiosk use, indicating consistent reliance on the kiosk throughout the year. In contrast, 46% of users had high seasonality, implying that their water needs fluctuated significantly depending on the time of year. The seasonality in household water kiosk use was significantly related to financial sustainability ($\chi 2 = 0.001$, $p < 0.05$). Users with low seasonality in their water kiosk use exhibit a higher proportion of high financial sustainability at 29.3%, whereas those with high seasonality contributed to high financial sustainability at a lower rate of 7.8%.

4.5.4 Influence of Household Water Use Characteristics on Financial Sustainability

Table 4.6 below shows the summary of binary logistic regression analysis showing user characteristics as predictors of financial sustainability of water kiosk services. The odds ratios and p-values help us understand the strength and significance of the relationships between user characteristics and financial sustainability. Table 4.8 provides the output of the regression analysis on influence of household water use characteristics on financial sustainability.

Table 4.5: Binary Logistic Regress Model Analysis

Predictor	B	SE	Odds ratio	P-value
Main source of drinking water				
(Borehole kiosk (public))				
Dam/Pan/River/Lake	-0.07	0.57	0.93	0.90
Hand pump (public/private)	0.59	0.98	1.80	0.55
Harvested Rainwater	0.53	0.51	1.69	0.30
Spring (protected/unprotected)	-15.37	714.71	0.00	0.98
Tap (public/private plot)	0.34	0.54	1.40	0.54
Vendor/Bottled water	-15.86	1,455.40	0.00	0.99
Frequency of collecting water from borehole kiosk				
(Never)				
Half the times	0.28	0.53	1.32	0.595
Always	0.84	0.57	2.32	0.142
Satisfaction with kiosk water for drinking				

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

(Dissatisfied)				
Satisfied	1.24	0.49	3.46	0.011
How long it takes to fetch water from borehole kiosk (Minutes)				
(30 & above)				
20 - 29	0.09	0.37	1.09	0.815
10 - 19	0.75	0.39	2.12	0.052
Below 10	1.26	0.33	3.52	< .001
Seasonality in Household Water Kiosk Use				
(Low)				
High	2.42	0.26	11.20	< .001

*Note. Estimates represent the log odds of "Financial Sustainability = High" vs. "Financial Sustainability = Low"
*Reference Categories in Brackets

(Field Results, 2022)

The analysis revealed that the choice of the main source of drinking water does not have a statistically significant impact on the financial sustainability of water kiosk services. Users who primarily rely on water from open sources (such as Dam/Pan/River/Lake), hand pump (whether public or private), harvested rainwater, spring (whether protected or unprotected), tap (whether public or private plot), or vendor or bottled water do not significantly differ in their likelihood to contribute to high financial sustainability when compared to users who depend on the borehole water kiosk (public). This suggests that regardless of the main source of drinking water, users have similar odds of supporting high financial sustainability of the kiosk service.

The frequency of fetching water from the borehole kiosk, whether "Never," "Half the times," or "Always," was not found to be a significant predictor of financial sustainability. Users who fetch water more or less frequently from the kiosk did not exhibit significant differences in their likelihood to contribute to high financial sustainability. This suggests that frequency of use does not significantly affect the odds of contributing to high financial sustainability of the kiosk service. Other factors may be more influential in this regard.

User satisfaction with the quality of kiosk water emerged as a significant predictor of financial sustainability. Those who expressed satisfaction with the water they obtained from the borehole water kiosks were significantly more likely to support high financial sustainability (odds ratio = 3.46, p = 0.011). This means that users who were satisfied with the water quality had 3.46 times

ST. PAUL'S UNIVERSITY

higher odds of supporting high financial sustainability compared to users who were dissatisfied. Ensuring water quality that meets users' satisfaction is crucial for financial sustainability.

The time it takes users to fetch water from the borehole kiosk was also an important predictor. Users who spent less than 10 minutes fetching water from the kiosk have the highest odds of contributing to high financial sustainability (odds ratio = 3.52, $p < 0.001$). Users who spent 10-19 minutes had moderately increased odds of high financial sustainability, although this result is only marginally significant (odds ratio = 2.12, $p = 0.052$). However, users who took longer, specifically 20-29 minutes or 30 minutes and above, did not show a significant difference in financial sustainability when compared to those who spent 30 minutes or more. This means that users who spend less than 10 minutes collecting water have 3.52 times higher odds of supporting high financial sustainability compared to those who spend 30 minutes or more. Shorter waiting times appeared to be crucial for high financial sustainability.

The seasonality in household water kiosk use was a robust predictor of financial sustainability. Users who experienced high seasonality in their water kiosk use, meaning their usage patterns vary significantly throughout the year, were markedly more likely to contribute to high financial sustainability (odds ratio = 11.20, $p < 0.001$). This means that users with high seasonality in water kiosk use have 11.20 times higher odds of supporting low financial sustainability compared to users with low seasonality. Understanding and adapting to these seasonal usage patterns is essential for maintaining high financial sustainability.

The results suggest that user characteristics such as the source of drinking water, satisfaction with kiosk water, time spent collecting water, and seasonality in use are important factors associated with the financial sustainability of water kiosk services. These findings can guide strategies to improve financial sustainability, including addressing user satisfaction, reducing waiting times, and promoting consistent use throughout the year.

As a conclusion, the quotes from one operator captured:

ST. PAUL'S UNIVERSITY

"The kiosk operator in my area has a myriad of challenges, the villagers are rude and non-co-operative when it comes to making payments, this is owing to the fact that they live close to River XYZ, where they draw and use untreated water. There are also some manually constructed boreholes which supply water. The few who come to our kiosks therefore would be looking for water for cooking and drinking. This then leads us to lower the price of water to five shillings for 2 twenty litre containers. Another challenge is that our water is salty and there is nothing you can do to the mediate this saltiness." Female Operator #3 Seme FGD.

4.6 Influence of User Household Sense of Ownership on Financial Sustainability

The second objective of this study was to assess the influence of user households' sense of ownership on the financial sustainability of community-managed borehole water kiosk services within Kisumu County. Sense of ownership was assessed based on individual household payment of borehole kiosk membership fees, belief that drinking water system was community-owned and or that the water system was owned by people in the village.

4.6.1 Household Sense of Water Kiosks and Association with Financial Sustainability

The cross tabulations in Table 4.9 below shows the association between the user households' sense of ownership and financial sustainability of borehole water kiosk services. It gives a descriptive frequency finding on the user households' sense of ownership of borehole water kiosk services.

Table 4.6: Household Sense of Ownership of Borehole Water Kiosk

Characteristics	Frequency	Percent
Payment of membership?		
No	401	87.2%
Yes	59	12.8%
This is OUR COMMUNITY'S drinking water system		
Not true at all	15	3.3%
Very true	445	96.7%
The water system is owned by all the people who live in this village		
Not true at all	160	34.8%
Very true	300	65.2%

(Field Results, 2022)

ST. PAUL'S UNIVERSITY

In terms of the payment of membership fees, it is evident that a substantial majority of respondents, accounting for 87.2%, do not pay these fees. Conversely, only 12.8% of the respondents indicated that they do pay membership fees. This suggests that a significant portion of user households was not financially contributing to the operation of the borehole water kiosk services. Users who choose to pay membership fees are notably more likely to be associated with a high level of financial sustainability, constituting 62.7% of this group. Conversely, among users who do not pay membership fees, the majority, accounting for 66.6%, are associated with a low level of financial sustainability. These findings suggest that financial contributions from users, in the form of membership fees, play a critical role in strengthening the financial sustainability of water kiosk services. The p-value for this metric is less than 0.001, confirming a statistically significant association, as shown in Table 4.10.

Regarding the belief that the drinking water system is community-owned, an overwhelming 96.7% of the respondents expressed a strong belief in this idea. This high percentage underscores the perception among user households that the drinking water system is indeed a community-owned resource. However, further analysis reveals that whether users strongly believe that the water system is community-owned or not at all, the percentages of those associated with low and high levels of financial sustainability remain similar. Among users who do not believe at all that the water system is community-owned, 60.0% are associated with a low level of financial sustainability, while among those who strongly believe in community ownership, 62.9% share this association. Similarly, in terms of high financial sustainability, 40.0% of users who do not believe at all in community ownership are associated with it, compared to 37.1% of those who strongly believe in community ownership. With a p-value of 0.793, it is evident that the belief in community ownership does not significantly impact the financial sustainability of these services.

ST. PAUL'S UNIVERSITY

Table 4.7: Cross Tabulation of User Sense of Ownership and Financial Sustainability

Ownership aspect	Response	Overall Percentage	Financial Sustainability of water kiosk services		P-value
			Low	High	
Payment of membership	Pay	12.8%	37.3%	62.7%	>.001
	Don't Pay	87.2%	66.6%	33.4%	

Community own water system	Not true at all	3.3%	60.0%	40.0%	0.793
	Very true	96.7%	62.9%	37.1%	
Village people own water system	Not true at all	34.8%	50.0%	50.0%	>.001
	Very true	65.2%	69.7%	30.3%	

(Field Results, 2022)

Coming to the belief that the water system is owned by people in the village, the responses are less skewed in distribution. While 65.2% of respondents strongly believe that the water system is owned by individuals in their village, a notable 34.8% do not share this belief. Users who strongly believe that the water system is owned by people in the village are more likely to be associated with a low level of financial sustainability, constituting 69.7% of this group. Conversely, among users who do not believe at all that the water system is owned by people in the village, 50.0% are associated with a low level of financial sustainability. In contrast, when it comes to high financial sustainability, 50.0% of users who do not believe at all in village people ownership are associated with it, compared to 30.3% of those who strongly believe in village people ownership. This intriguing result suggests that strong beliefs in village people ownership may be negatively affecting the financial sustainability of water kiosk services.

4.6.2 Influence of Households Sense of Ownership on Financial Sustainability

In the binary logistic regression analysis, the researcher examined payment of membership, the community's own water system, and village people own water system as predictors of financial sustainability of water kiosk services. Table 4.11 below shows a binary logistic regression model summary result of user households' sense of ownership and financial sustainability of water kiosk services. The reference categories are in brackets and each regression coefficient is associated with standard error, odds ratio, and the Pearson's chi-square p-value as test of statistical significance at 0.1 and 0.05. The focus is on the odds ratio and the p-value (significance level) to understand the influence of these predictors on financial sustainability.

Table 4.8: Influence of Sense of Ownership on Financial Sustainability

Predictor	B	SE	Odds ratio	P-value

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

Payment of membership				< .001
(Don't Pay)				
Pay	1.291	0.297	3.638	
Community own water system				.799
(Not true at all)				
Very true	0.146	0.571	1.157	
Village people own water system				< .001
(Not true at all)				
Very true	-0.894	0.208	0.409	

*Note. Estimates represent the log odds of "Financial Sustainability = High" vs. "Financial Sustainability = Low"
*Reference Categories in Brackets
(Field Results, 2022)

Results show that users who reported that they pay membership fees were approximately 3.638 times more likely to have high financial sustainability compared to those who do not pay. The p-value (p< .001) indicates strong statistical evidence that payment of membership significantly influences financial sustainability, with a positive association. This result may suggest that financial contributions in the form of membership fees play a crucial role in ensuring high financial sustainability for water kiosk services. Users who contribute financially are likely to have a vested interest in the borehole kiosk's well-being. This financial commitment strengthens the service's overall sustainability because member contribution may imply having more funds for maintenance, repairs, and improvements of the water facilities.

On the other hand, the result indicated that users who strongly believe that the water system is owned by people in the village are approximately 0.409 times less likely to have high financial sustainability compared to those who do not believe this strongly. The p-value (p< .001) confirms the statistical significance of this association, suggesting that strong beliefs in village people's ownership have a counter-intuitive negative impact on financial sustainability. This result is intriguing and could be that beliefs in village ownership may imply a perception that other villagers are responsible for the system's functioning, potentially leading to reduced individual contributions.

Users who believed that the water system is community-owned were 1.157 times more likely to have high financial sustainability compared to those who do not. However, the difference is not statistically significant (p = .799). This result suggests that whilst there is a positive trend in

ST. PAUL'S UNIVERSITY

favour of users who believe in community ownership, this association is not statistically significant. It implies that the strength of belief in community ownership alone may not be a strong determinant of financial sustainability.

Based on the consistent evidence presented and derived from the cross-tabulation and logistic regression herein, it can be inferred that payment of membership fees significantly increases the likelihood of high financial sustainability. This is potentially due to the individual initiatives towards the borehole kiosk well-being. On the other hand, perception in community ownership of the water system may not always translate into tangible financial support, and hence does not positively or significantly contribute to financial sustainability of borehole water kiosk services.

4.7 Influence of Technical Factors on Financial Sustainability of Borehole Water Kiosks

4.7.1 Descriptive Results on the Technical Designs of Borehole Water Kiosks

The third objective of this study was to analyse the influence of water kiosks' technical design and layout on the financial sustainability of community-managed borehole water kiosk services within Kisumu County, Kenya. The technical factors examined for this objective included perception on water pressure from the borehole kiosk, year of borehole and kiosk establishment, availability of water when needed, hours when kiosk is open, functional state of water kiosk, time of the day when kiosk functions and presence of a technician or plumber. Table 4.12 presents the descriptive frequencies on the findings of these variables.

Table 4.9: Technical Designs and Layout of Borehole and Water Kiosks

Technical Designs	Frequency	Percent
How much pressure does the water borehole kiosk usually come when open?		
Low pressure	53	11.5%
Moderate pressure	244	53.2%
High pressure	162	35.3%
Is your kiosk drinking water source available when needed?		
No, not functioning	1	0.3%
Yes, functioning but not well	267	58.0%
Yes, functioning well	192	41.7%
What time does the water kiosk operate during the day?		
No time schedule	20	4.3%
All day long	342	74.3%

ST. PAUL'S UNIVERSITY

06 - 10 AM (morning)	58	12.6%
04 - 07 PM (evening)	22	4.8%
Other times	18	3.9%
Is there a technician or plumber to look after your main drinking water kiosk?		
No	121	26.3%
Yes	339	73.7%

(Field Results, 2022)

As corroborated from the FGDs, the participants reported that water pressure was low and decreases as the day goes by. Kiosk operators have developed a strategy to ensure that water supply is not severely affected by reduced water pressure. For example, one was quoted as saying:

> *"The pressure is never enough to fill more than one in a day. It was set up in such a way that the pressure decreases as the day progresses, so by 1 pm, the pressure will have reduced considerably. Beyond that the pressure will be too low, so the following day, I have to direct it to another pump, that will serve a kiosk like ..., which is about two kilometres above us, from there it can flow to ... kiosk. We then monitor if there could be a line with too much pressure so we ease the flow".* Female Operator 6 at Nyakach FGD

4.7.2 Association of Technical Factors on Financial Sustainability

The data indicated that the perception of water pressure from the borehole kiosk varies among users. Approximately 11.5% of respondents reported experiencing low water pressure. In contrast, 35.3% of users reported having high water pressure while a majority, accounting for 53.2%, perceived the pressure as moderate. Users who reported experiencing low water pressure were more likely to have high financial sustainability (52.8%) compared to those with moderate (32.0%) or high (40.1%) water pressure. As shown in Table 4.8, this finding revealed that water pressure has a statistically significant association with the financial sustainability of kiosk services ($p = 0.011$). This finding may suggest that efficient water usage due to lower pressure might potentially contribute to cost savings, leading to higher financial sustainability.

Table 4.10: Association of Technical Factors and Financial Sustainability

Technical factors	Response	Overall Percentage	Financial Sustainability of water kiosk services		P-value
			Low	High	
Water pressure					0.011
	Low pressure	11.5%	47.2%	52.8%	
	Moderate pressure	53.2%	68.0%	32.0%	

ST. PAUL'S UNIVERSITY

	High pressure	35.3%	59.9%	40.1%	
Borehole establishment (Year)					0.352
	2017-2022	49.8%	61.6%	38.4%	
	2009-2016	13.7%	57.1%	42.9%	
	2001-2008	36.5%	66.7%	33.3%	
Kiosk establishment (Year)					0.188
	2017-2022	42.2%	61.9%	38.1%	
	2009-2016	27.4%	57.9%	42.1%	
	2001-2008	30.4%	68.6%	31.4%	
Water available when needed.					0.744
	No	2.6%	58.3%	41.7%	
	Yes	97.4%	62.9%	37.1%	
Duration opens per day (hours)					0.054
	Once per day	1.0%	25.0%	75.0%	
	Twice per day	4.6%	42.1%	57.9%	
	Thrice per day	3.6%	66.7%	33.3%	
	More than 4 times	89.6%	64.2%	35.8%	
	Not applicable	1.2%	100.0%	0.0%	
Functional state					0.74
	Yes, functioning but not well	58.2%	62.9%	37.1%	
	Yes, functioning well	41.8%	62.5%	37.5%	
Time of day when Open					0.71
	All day long	74.3%	63.7%	36.3%	
	6-10 AM	12.6%	58.6%	41.4%	
	4-7 PM	4.8%	68.2%	31.8%	
	No time schedule	4.3%	65.0%	35.0%	
	Other times	3.9%	50.0%	50.0%	
Availability of technician or plumber					0.001
	No	26.3%	39.2%	22.9%	
	Yes	73.7%	60.8%	77.1%	

(Field Results, 2022)

ST. PAUL'S UNIVERSITY

Regarding the establishment years of the boreholes and kiosks, the data shows that nearly half (49.8%) of the boreholes were established between 2017 and 2022. A smaller percentage, 13.7%, dates back to the period between 2009 and 2016, while 36.5% were established between 2001 and 2008. Similarly, the establishment years of the kiosks reveal that 42.2% of kiosks were established between 2017 and 2022, 27.4% between 2009 and 2016, and 30.4% between 2001 and 2008. Considering the establishment years of boreholes and kiosks, no statistically significant associations were found with financial sustainability ($p = 0.352$ and $p = 0.188$, respectively). These results may indicate that the year of establishment alone does not appear to be a significant determinant of financial sustainability for these services, and other factors may

play a more prominent role. The findings on association of technical design and layout factors are shown in Table 4.13.

The data indicated that water was available when needed, with 97.4% of respondents reporting consistent access to water. Only 2.6% of respondents indicated that water was not available when needed. Similarly, the presence or absence of water when needed did not show a statistically significant association with financial sustainability ($p = 0.744$). This suggests that consistent water availability alone may not be the sole driver of financial success for kiosk services.

Regarding the duration kiosks remain open per day, 89.6% of kiosks open more than four times a day. Smaller percentages indicate kiosks with varying opening frequencies, including once per day (1.0%), twice per day (4.6%), or thrice per day (3.6%). Additionally, a small fraction (1.2%) reported that opening hours were not applicable, possibly indicating unique operational circumstances. The duration for which a kiosk opens per day shows statistical significance association at 10% significance level ($p = .054, < .1$). It was evidence that there was a trend suggesting that kiosks opening more times per day (e.g., twice, or thrice) may be associated with higher financial sustainability. However, the result is not robust enough to draw definitive conclusions.

The functional state of the kiosks was diverse; with 58.2% of respondents reporting that the kiosks' function but not well, while 41.8% reported that the kiosks' function well. These findings suggest that while a significant portion of kiosks may have operational issues, there was also a substantial number that were functioning efficiently. The functional state of kiosks, whether functioning well or not well, did not show a statistically significant association with financial sustainability ($p = 0.740$). This may imply that the functional state of the kiosk, as reported by users, does not significantly impact financial sustainability.

Regarding the time of day when kiosks are open, the majority of users (74.3%) reported that the kiosk is open all day long. Others reported time slots include 6-10 AM (12.6%), 4-7 PM (4.8%),

ST. PAUL'S UNIVERSITY

no specific time schedule (4.3%), and other unspecified times (3.9%). The time of day when the kiosk is open does not appear to be a significant factor in determining financial sustainability (p = 0.710). Users seem to have similar levels of financial sustainability regardless of the kiosk's operating hours.

Regarding the presence of a kiosk technician or plumber, the data indicates a 73.7% of respondents reporting the presence of a technician or plumber and 26.3% indicating the absence of one. The presence of a technician at the kiosk shows a statistically significant association with the financial sustainability (p = 0.001). While strongly statistically significant, there was a trend that kiosks with technician (77.1%) may have higher financial sustainability compared to those without technician (22.9%). This result could be due to the critical role associated with having technicians and the potential benefits of reducing the disruptions in the water flow at the kiosks.

4.7.3 Influence of Technical Factors on Financial Sustainability

Results show that users who reported experiencing low water pressure were found to be 1.32 times more likely to have high financial sustainability compared to those users experiencing high water pressure. However, this result was not statistically significant at the 0.1 level (p = 0.443). On the other hand, users with moderate water pressure were 0.64 times as likely to have high financial sustainability compared to those with high pressure whose statistical significance is at 0.1 significance level (p = 0.060). These findings suggest that while there may be a slight association between water pressure and financial sustainability, it is not strong enough to be considered significant. These findings are shown in Table 4.14.

Kiosks associated with their establishment between 2009 and 2016 were 1.61 times more likely to have high financial sustainability compared to the reference category (2001-2008), although this result was not statistically significant at the 0.1 level (p = 0.107). Similarly, users associated with kiosks established between 2017 and 2022 were 1.44 times more likely to have high financial sustainability compared to the reference category (2001-2008), but this result also did not reach statistical significance (p = 0.165).

ST. PAUL'S UNIVERSITY

Table 4.11: Influence of Technical Factors and Financial Sustainability

Predictor	B	SE	Odds ratio	P-value
Water pressure				
(High pressure)				
Low pressure	0.28	0.36	1.32	0.443
Moderate pressure	-0.44	0.24	0.64	0.060
Kiosk establishment (Year)				
(2001-2008)				
2009-2016	0.47	0.29	1.61	0.107
2017-2022	0.36	0.26	1.44	0.165
Water available when needed.				
(Yes)				
No	0.71	0.83	2.04	0.392
Duration opens per day (hours)				
(More than 4 times)				
Thrice per day	0.01	0.67	1.01	0.988
Twice per day	1.27	0.65	3.58	0.050
Once per day	1.84	1.30	6.29	0.157
Not applicable	-14.98	712.68	0.00	0.983
Functional state				
(Functioning but not well)				
Functioning well	-0.11	0.23	0.90	0.631
Time of day when Open				
(All day long)				
6-10 AM	0.16	0.34	1.18	0.635
4-7 PM	-0.69	0.58	0.50	0.235
No time schedule	-0.78	0.67	0.46	0.244
Other times	0.05	0.70	1.05	0.947
Availability of attendant				
(No)				
Yes	-0.27	0.22	0.76	0.209

*Note. Estimates represent the log odds of "Financial Sustainability = High" vs. "Financial Sustainability = Low"
*Reference Categories in Brackets

(Field Results, 2022)

ST. PAUL'S UNIVERSITY

Respondents who reported that water was not available when needed were 2.04 times more likely to have high financial sustainability compared to those with water available when needed. However, this result was not statistically significant at the 0.1 level (p = 0.392). Plausible reasons for this lack of significance could include variations in the reasons for water unavailability, differences in users' coping mechanisms, or the influence of other factors not included in the analysis.

Users associated with kiosks that open twice per day were 3.58 times more likely to have high financial sustainability compared to those associated with kiosks that open more than four times per day, and this result was statistically significant at the 0.1 level (p = 0.050). While users associated with kiosks opening once per day were 6.29 times more likely to have high financial sustainability, this result did not reach statistical significance (p = 0.157) because of the negligible number of respondents who fall in this category, leading to inflated odds ratio. Plausible reasons for the significance of opening twice per day could include increased convenience for users or more efficient water management practices, which contribute to higher financial sustainability.

Respondents associated with kiosks functioning well were 0.90 times as likely to have high financial sustainability compared to those with kiosks functioning but not well. However, this result was not statistically significant at the 0.1 level (p = 0.631). Plausible reasons for this lack of significance could include variations in what constitutes "functioning well" across different kiosk locations, differences in user perceptions of functionality.

4.7.4 Other Technical Factors on Financial Sustainability

The results from the analysis of data from the FGDs and KII strengthened the findings from the household data. These were categorized as kiosk network design and layout. Some of the voices of the operators included the fact that the design layout for the kiosks varied from one water kiosk to the next. For example, water operator from Nyakach shared that their borehole has 2 raised tanks while the kiosks have only one tank each:

> *"The boreholes, each have two raised tanks while the kiosks only have one tank each".*
> Male Operator #2 Nyakach, FGD.

This description differs from that of BH1 borehole where the operator shared that the water stand was constructed about 100 meters away. The rationale for the design was to optimize the water rotation. However, this design interfered with the pressure and people close to the borehole were not receiving adequate water. He continues to say that the community was not receiving enough water whenever the volume of water reduced because the water pressure reduced in such

ST. PAUL'S UNIVERSITY

instances. Those with stepped down pipes were the most affected and were not getting adequate water supply.

> *"The borehole at BH1 was drilled and the water stand was constructed about 100 meters away so that the rotation does not interfere with the borehole. This brought a problem in that it interfered with pressure so that some people living very close to the borehole cannot get water. This brought a lot of problems in the community, whenever the volume of the water reduced, the pressure would not be enough to get water to people who have stepped down pipes. We can therefore say here that the design actually interfered with the supply".* Male Operator #1 Nyakach, FGD.

Two participants were of a contrary opinion. One respondent believed that the design was fine and proper assessment was done before installation but needs assessment was not done to establish on the actual water demand.

> *"In my opinion, there was nothing wrong with the design; the problem comes about when there are a number of people who have diverted the water. The area is flat so issues of pressure or the lack of it do not arise. The water engineer needs to be consulted in order to help identify the actual problem. Maybe the water operator or technician can say something. Personally, I really do not have a problem even with my pipes"* Female Operator #3 Nyakach, FGD.

The other respondent believed that the main problem is people diverting the water. He believed that since the area is flat the issue of pressure does not suffice. He also believed that there is a problem that needs to be identified and resolved by experts. The inadequate water supply creates tensions when consumers do not receive a regular supply.

> *"The way I see it; the design was fine. Proper assessment was done before installation except that the needs assessment was not done to establish the actual demand and strategies on meeting the same. Therefore, with time demand outstrips the supply and this creates tensions when some people especially private consumers fail to get their regular supply.* Female Operator #3 Nyakach, FGD.

ST. PAUL'S UNIVERSITY

4.8 Influence of Household Perception on Water Committee and Sustainability

The specific objective of this section was to examine the influence of borehole water committee governance on the financial sustainability of community-managed borehole water kiosk services within Kisumu County, Kenya. It has looked at the user household perception on the borehole water committee, the association and influence of the water committee on the financial sustainability.

4.8.1 User Household Perceptions on Borehole Water Committee Functions

It was assumed that there existed a water management committee for each borehole and water kiosk. The possible water committee functions included management of the water system (borehole, its layout, infrastructures and kiosks); borehole water kiosk management (water kiosks services), maintenance of the borehole and kiosk water system, coordinating repairs of the water system, controlling the use of the water kiosks (who can or cannot access the water services), and generating-spending revenues collected for borehole water kiosks. This section sought to establish existence of water committee for managing the water system, related specific functions and frequency of their meeting with the beneficiaries. As for the existence of the committees, 78.7% of households affirmed that their water systems had a management committee, while 21.3% reported non-existing water committees. This was corroborated by feedback from the focus group discussions with operators who also reported some boreholes and kiosks committees either did not exist or were non-functional. In such water boreholes and kiosks, the discussions revealed that such functions of committees were handled by either one of community members, in most cases the chairperson or treasurer. However, such arrangements demonstrated limited accountability to the members or users of the water kiosks.

ST. PAUL'S UNIVERSITY

Table 4.12: User Household Perception on Water Committee Governance

Characteristics	Frequency	Percent
Is there a water committee that is responsible for management of the borehole?		
No	98	21.3%
Yes	362	79.7%
Do you know the members of the committee managing the water point?		
No	231	50.2%
Yes	229	49.8%
How often does the water management committee meet with water users to discuss issues about the water system?		
Never	169	36.7%
Monthly	110	23.9%
Bimonthly (after two months)	5	1.1%
Quarterly (after three months)	9	2.0%
Semi-annually (after six months)	17	3.7%
Annually (after twelve months)	61	13.3%
As needed	89	19.3%
Is there a water committee that is responsible for management of the		

borehole water kiosk?		
No	98	21.3%
Yes	362	78.7%
Do you have a schedule for opening and closing your BH water kiosks?		
No	39	8.5%
Yes	421	91.5%
Do you have an operator or attendant at the borehole water kiosk?		
No	228	49.6%
Yes	232	50.4%
How satisfied are you about where the kiosk is sited?		
Dissatisfied	18	3.9%
Satisfied	442	96.1%

(Field Results, 2022)

A majority (73.3%) of households indicated the committee was responsible for the management of the borehole water kiosk. On the other hand, 26.7% indicated the committee did not perform such management tasks of borehole water kiosks. The management of the borehole also entailed establishment of water operation schedule which scheduled opening and closure times. Furthermore, majority of households (77%) who reported the water committees' functions included management of water kiosk, maintenance, repairs coordination, use control; generating and spending revenue also responded that there was a time when water was not available for more than one week. Other findings are presented in Table 4.15.

4.8.2 Association of Water Kiosk Governance with Financial Sustainability

The majority of respondents (78.7%) indicated that there was a committee in place to manage the borehole kiosk. When we compare the financial sustainability levels between those with and without a committee, both groups had a similar percentage, with 63.0% of kiosks with a committee in the low financial sustainability group and 37.0% in the high financial sustainability group. The p-value for this comparison is 0.893, indicating that the presence of a committee does not seem to be statistically associated with financial sustainability.

Among the respondents, about half (50.2%) reported that they did not know committee members, while the remaining 49.8% indicated that they were aware of committee members. When we compare the financial sustainability levels, a noteworthy pattern emerges. Those who reported not knowing committee members had a majority (55.4%) in the low financial sustainability group, and 44.6% in the high financial sustainability group. On the other hand, among those who

ST. PAUL'S UNIVERSITY

knew committee members, a substantial 70.3% were in the high financial sustainability group, while only 29.7% were in the low financial sustainability group. This indicates a significant association between knowing committee members and higher financial sustainability, as evidenced by a p-value of 0.001. The results of association between the water committee governance and the financial sustainability have been summarized in Table 4.16.

Table 4.13: Association of Water Committee Governance with Financial Sustainability

Governance factors	Response	Overall Percentage	Financial Sustainability of water kiosk services		P-value
			Low	High	
Committee in place to manage borehole kiosk					0.893
	No	21.3%	62.2%	37.8%	
	Yes	78.7%	63.0%	37.0%	
Do you know committee members					0.001
	No	50.2%	55.4%	44.6%	
	Yes	49.8%	70.3%	29.7%	
Frequency of management committee meetings					0.106
	Never	36.7%	56.8%	43.2%	
	Monthly	23.9%	66.4%	33.6%	
	Bimonthly	1.1%	40.0%	60.0%	
	Once every 3 months	2.0%	77.8%	22.2%	
	Once every 6 months	3.7%	88.2%	11.8%	
	Once per year	13.3%	60.7%	39.3%	
	As needed	19.3%	66.3%	33.7%	
Committee in place to manage borehole kiosk					0.893
	No	21.3%	62.2%	37.8%	
	Yes	78.7%	63.0%	37.0%	
There is schedule for opening and closing borehole kiosk					0.119
	No	8.5%	51.3%	48.7%	
	Yes	91.5%	63.9%	36.1%	

(Field Results, 2022)

ST. PAUL'S UNIVERSITY

The respondents reported various frequencies of management committee meetings. It was found that 36.7% of respondents said they never had frequent meetings to discuss the water system. The majority mentioned meetings occurring either monthly (23.9%) or "as needed" (19.3%), with lower percentages for other frequencies. When comparing financial sustainability levels, some interesting observations emerge. For instance, those who reported meetings happening "once every 3 months" had a remarkable 77.8% in the high financial sustainability group and 22.2% in the low financial sustainability group. However, the p-value for this comparison is

0.106, which exceeds the significance level of 0.1. This suggests that while there are differences in financial sustainability across meeting frequencies, they are not statistically significant.

Regarding the schedule for opening and closing the borehole kiosk, the majority of respondents (91.5%) reported that there was a schedule in place. When comparing low and high levels of financial sustainability, those without a schedule had 51.3% in the low financial sustainability group and 48.7% in the high financial sustainability group. In contrast, those with a schedule had 63.9% in the high financial sustainability group and 36.1% in the low financial sustainability group. However, the p-value for this comparison is 0.119, which is above the significance level of 0.1. This suggests that the presence of a schedule for opening and closing the kiosk is not statistically associated with financial sustainability.

4.8.3 Influence of Water Kiosk Governance on Financial Sustainability

Respondents who reported that they do not know committee members were associated with lower log odds of achieving high financial sustainability. The odds ratio of 0.54 suggests that those who do not know committee members are approximately 0.54 times as likely to achieve high financial sustainability compared to those who do know committee members. Importantly, the p-value for this predictor is 0.002, which is below the significance level of 0.1, indicating a statistically significant association. In practical terms, this may mean that knowing committee members is linked to higher financial sustainability.

ST. PAUL'S UNIVERSITY

Table 4.14: Influence of Water Committee Governance on Financial Sustainability

Predictor	B	SE	Odds ratio	P-value
Committee in place to manage borehole kiosk				
(No)				
Yes	0.13	0.26	1.13	0.624
Do you know committee members				
(No)				
Yes	-0.62	0.20	0.54	0.002
Frequency of management committee meetings				
(Never)				
As needed	-0.41	0.29	0.67	0.152
Bimonthly	0.76	0.94	2.13	0.421
Monthly	-0.48	0.27	0.62	0.071
Once every 3 months	-0.95	0.83	0.39	0.251

Once every 6 months	-1.74	0.78	0.18	0.026
Once per year	-0.21	0.32	0.81	0.512
Committee in place to manage borehole kiosk				
(No)				
Yes	0.13	0.26	1.13	0.624
There is schedule for opening and closing borehole kiosk				
(No)				
Yes	-0.49	0.35	0.61	0.157

*Note. Estimates represent the log odds of "Financial Sustainability = High" vs. "Financial Sustainability = Low"
*Reference Categories in Brackets
(Field Results, 2022)

The presence of a committee in place to manage the borehole kiosk was not statistically significant at the 0.1 level. The odds ratio of 1.13 implies that having a committee in place is associated with a slight increase in the odds of achieving high financial sustainability. Importantly, the p-value for this predictor is 0.624, which is above the significance level of 0.1. This indicates that the presence of a committee does not have a statistically significant impact on financial sustainability.

The frequency of management committee meetings showed varied effects on financial sustainability. Respondents who reported meetings "once every 6 months" are associated with significantly lower odds of achieving high financial sustainability. Other categories of meeting frequency displayed different impacts on financial sustainability, but none of the odds ratios for these categories were below 0.1, which is the significance level considered here. The p-values for the different categories ranged from 0.026 to 0.624. Among these, only the category "once every 6 months" had a p-value below 0.1, indicating a statistically significant association between this infrequent meeting frequency and lower financial sustainability.

The presence of a schedule for opening and closing the borehole kiosk was associated with financial sustainability. Respondents who reported not having a schedule were associated with lower log odds of achieving high financial sustainability. The odds ratio of 0.61 suggests that those without a schedule are approximately 0.61 times as likely to achieve high financial sustainability compared to those with a schedule. However, the p-value for this predictor is 0.157, which is above the significance level of 0.1. This implies that the presence of a schedule

ST. PAUL'S UNIVERSITY

for opening and closing the kiosk is not statistically significant in relation to financial sustainability.

4.8.4 Other Water Kiosk Governance Issues for Financial Sustainability

The operators FGDs and KII data also provided some results that triangulated the findings already presented, especially in the area of kiosk operations. Some participants stated that the water kiosk function differently in terms of the volume of supply and timing of operations, as decided by the committee and source of energy. The common phenomenon was that pumping water into the water tank the first activity of day. According to the participants, the source of power was either electricity or solar. However, to use the solar energy one has to wait until when the sun is hot. As guided by the water committee, the operators often supply to the schools and other institutions first before serving domestic and private consumers.

> *"Every morning on waking up, I make sure I pump water so that the two schools I serve with water are well supplied, it is important for the students to have water for drinking and washing their hands, so I pump water by 6 am. When using a solar pump, I have to wait for the sun to get hot, then I switch on the pump and water begins to flow around 9 am, I direct it to the school tank, which is the first storage, after it gets to a good level that can then overflow and serve others, I direct it to other tanks, the first tank serves four kiosks, namely KSK1, KSK2, KSK3, and KSK4".* Male Operator #3 Nyando FGD.

4.9 Influence of User Households' Participation in Financial Sustainability

The objection of this section was to assess the influence of user households' participation in borehole and water kiosks' governance on the financial sustainability of the community-managed water kiosks. This looked at whether or not a member from the user household was involved either in water supply management or as a committee member. It also looked at whether the user household contributed towards the establishment of the borehole kiosk; and participation in the previous committee meeting with the kiosk water users.

ST. PAUL'S UNIVERSITY

4.9.1 User Household Participation in Community-Managed Water Kiosk Governance

The researcher investigated whether user households participated in the governance of the community-managed boreholes and related water kiosks. On the other hand, 91.7% of household reported not participating in the establishment of the borehole-water kiosk, but only 8.3% affirmed their participation towards such establishment. In another aspect of residence, 62.8% of households reported they were living in areas that were beneficiaries to the established borehole-water kiosks. However, 37.2% of households benefiting from the borehole water kiosks reported not to be living within benefiting areas. Table 4.18 presents a summary of other participation characteristics studied.

Table 4.15: Household Participation in Borehole and Water Kiosks Governance

Characteristics	Frequency	Percent
Someone from this household is involved in the management of the water supply system in this community?		
No	397	86.3%
Yes	63	13.7%
Someone from this household is a member of the water management committee in the management of the water supply system in this community?		
No	416	90.4%
Yes	44	9.6%
Did your household participate in the last Water committee meeting with the users?	102	22.2%
No, a meeting was not held	236	51.3%
No, I was not invited	36	7.8%
No, I was invited but did not attend	86	18.7%
Yes, I attended		

(Field Results, 2022)

ST. PAUL'S UNIVERSITY

4.9.2 Association of Users Participation in Governance with Financial Sustainability

Regarding household (HH) member involvement in management of water supply services, it was evident that a significant majority of households, accounting for 86.3%, do not have a household member actively participating in the day-to-day management of the kiosk or water service. It was found that, among households, no member was involved in the management of the kiosk or water service. It was revealed about 63.5% experience low levels of financial sustainability,

while 36.5% have a high level of financial sustainability. In households with at least one member involved in management, 58.7% experience low financial sustainability, and 41.3% have a high level of financial sustainability. The associated p-value of 0.469 suggests that the difference in financial sustainability between these two groups is not statistically significant. This indicates that having a household member involved in management does not appear to significantly impact financial sustainability of the borehole kiosk. These findings have been presented in Table 4.19.

Similarly, when considering whether a HH member was a committee member, the results show that the majority, at 90.4% of households, do not have a household member serving as a committee member responsible for overseeing the kiosk or water service. It was observed that among households where no member serves as a committee member, 63.0% experience low levels of financial sustainability, while 37.0% have a high level of financial sustainability. In households with at least one member as a committee member, 61.4% experience low financial sustainability, and 38.6% have a high level of financial sustainability. The associated p-value of 0.833 suggests that there is no statistically significant difference in financial sustainability between these two groups. Hence, household representation on the committee does not seem to be significantly associated with the financial sustainability of borehole kiosk.

ST. PAUL'S UNIVERSITY

Table 4.16: Association of User Households Involvement in Kiosk Management

HH participation in Governance	Response	Overall Percentage	Financial Sustainability of water kiosk services		P-value
			Low	High	
HH member involved in management					0.469
	No	86.3%	63.5%	36.5%	
	Yes	13.7%	58.7%	41.3%	
HH member is committee member					0.833
	No	90.4%	63.0%	37.0%	
	Yes	9.6%	61.4%	38.6%	
HH member attended last committee meeting					0.459
	No, a meeting was not held	22.2%	58.8%	41.2%	
	No, was not invited	51.3%	61.9%	38.1%	
	No, was invited but did not attend	7.8%	72.2%	27.8%	
	Yes, attended	18.7%	66.3%	33.7%	
HH contributed to					0.001

No	89.3%	70.1%	29.9%
Yes	10.7%	2.0%	98.0%

(Field Results, 2022)

Results show that a substantial portion, 51.3% of households, reported that they were not invited to the last committee meeting. Additionally, about 22.2% of households stated that no committee meeting was held. Among the households invited to the last committee meeting, 18.7% attended it, while 7.8% chose not to attend. It was found that those households where no committee meeting was held or where they were not invited, 58.8% experience low levels of financial sustainability, while 41.2% have a high level of financial sustainability. In households where members were invited but did not attend the last committee meeting, 72.2% experienced low financial sustainability, and 27.8% have a high level of financial sustainability. Among households where at least one member attended the last committee meeting, 66.3% experienced low financial sustainability, while 33.7% had a high level of financial sustainability. The associated p-value of 0.459 indicates that there is no statistically significant difference in financial sustainability based on attendance at the last committee meeting. Therefore, attending or not attending the meeting does not appear to be significantly associated with financial sustainability.

Regarding HH contributed to establishment of Kiosk, the majority of households (89.3%) did not contribute to the establishment of the kiosk or water service, suggesting that most households were not financially or otherwise involved in the initial setup or funding of the service. In contrast, a smaller fraction, 10.7%, reported contributing to the establishment of the kiosk. Households that did not contribute to the establishment of the kiosk are significantly more likely to experience low levels of financial sustainability, with 70.1% in this category. In contrast, households that contributed to the establishment of the kiosk experience a high level of financial sustainability, with 98.0% falling into this category. The highly significant p-value of 0.001 demonstrates a strong and statistically significant association between household contributions to the kiosk's establishment and high financial sustainability. This suggests that households that

ST. PAUL'S UNIVERSITY

were involved in the kiosk's initial establishment are far more likely to have a high level of financial sustainability.

4.9.2 Influence of Users Participation in Governance with Financial Sustainability

The analysis indicated that household members' involvement in the management of the kiosk does not significantly impact the odds of achieving high financial sustainability. The odds ratio associated with this predictor is 0.90, suggesting that households with members involved in management are approximately 0.90 times less likely to achieve high financial sustainability compared to those with no involvement. The p-value for this predictor is 0.801, which is much higher than the significance level of 0.1, indicating that involvement in management is not statistically significant in relation to financial sustainability.

Similarly, the presence of household members as committee members does not have a statistically significant impact on financial sustainability. The odds ratio for households with committee members is 1.04, indicating a slight increase in the odds of achieving high financial sustainability compared to households with no committee members. However, the p-value for this predictor is 0.939, which is much higher than the significance level of 0.1, indicating that committee membership is not statistically significant. Table 4.20 shows the outcomes of the binary logistics regression analysis.

Attendance or non-attendance at the last committee meeting also does not significantly affect financial sustainability. The odds ratios for different attendance categories range from approximately 1.24 to 1.40, suggesting marginal increases in the odds of achieving high financial sustainability, but none of these differences are statistically significant. The p-values for all attendance categories are above 0.1, further supporting the lack of statistical significance in this context.

Table 17: Influence of Users Participation in Governance in Financial Sustainability

Predictor	Estimate	SE	Odds ratio	P-value
HH member involved in management				

ST. PAUL'S UNIVERSITY

(No)				
Yes	-0.1035	0.41	0.90	0.801
HH member is committee member				
(No)				
Yes	0.0373	0.484	1.04	0.939
HH Member attended last committee meeting				
(No, a meeting was not held)				
No, was invited but did not attend	0.3308	0.432	1.39	0.444
No, was not invited	0.3346	0.268	1.40	0.213
Yes, attended	0.2139	0.338	1.24	0.527
HH contributed to establishment of Kiosk				
(No)				
Yes	-4.7509	1.019	0.009	< .001

*Note. Estimates represent the log odds of "Financial Sustainability = High" vs. "Financial Sustainability = Low"
*Reference Categories in Brackets
(Field Results, 2022)

On the other hand, household contributions to the establishment of the kiosk have a highly significant and substantial influence on financial sustainability. The odds ratio for households that did not contribute is 0.009, indicating that they are approximately 0.9% as likely to achieve high financial sustainability compared to those that did contribute. The p-value for this predictor is less than 0.001, signifying strong statistical significance. This underscores that household contributions to the kiosk's establishment are a critical factor associated with achieving high financial sustainability, with those who contributed far more likely to attain it.

4.9.3 Other Results of Users Participation in Governance with Financial Sustainability

The participants reported that repairs of broken down equipment take time and other equipment are never repaired. For instance, BH2 Kiosk pump broke down but has not been repaired hence the kiosk has not been able to supply the community with water. The pump broke down in 2016. The other challenge is vandalizing taps and pipes and frequent breakages of pipes.

> *"I am in charge of BH Kiosk. At first my grandfather was the one in charge, then he died and because I was around, I stepped in to represent him. Currently there is no water flow; there was low pressure which was not rectified. Whenever the pressure was good, I would be the one to pump the water, the old man could not manage. I could turn it on before going to school and the water would flow throughout. This particular kiosk also has a pump. I would only turn it off to give way for other tanks to also get their supply, otherwise, once pumped our water could flow continuously. We went on until the pump broke down and has never been repaired to date".* Male operator #5 Nyakach, FGD.

ST. PAUL'S UNIVERSITY

A respondent reported that remittance of payment for water used is a challenge and they have had to cut supply to the consumers sometimes.

> *"Another issue, a number of people with water in their homes, they have run ins with the management, they decided not to forward money with the result that they often have a lot of accrued debts, as much as 10000 shillings, the management locks up the water, people suffer especially women, and so the management opens up the water again, they still do not pay and wrangling continues".* Female Operator #1 Seme, FGD.

These results show the other critical role that the operators play in between the availability of the water service provision, to the extent that sometimes members of user household would love to volunteer to support supply of water. One participant, however, reported that the kiosk operators have several challenges, unlike areas that the demand of water kiosk service is higher than the supply. In such cases, the cost of water is therefore relatively lower in this area at 2 shillings per 20-litre jerricans. The other challenge is uncooperative customers who do not pay.

ST. PAUL'S UNIVERSITY

4.10 Influence of Land Ownership on Financial Sustainability

The objective in this section was to examine the significance of land ownership in moderating the influence of the user household characteristics, technical designing and governance factors on the financial sustainability of community-managed borehole water kiosk services. The moderating factors considered in this study included the geographical location of the user households (whether within the area considered for use); and the ownership of land where either the borehole or the water kiosks were located.

4.10.1 Land Ownership of Financial Sustainability of Water Kiosks

The borehole water system and infrastructure, including where the borehole was drilled and developed, the piping network, water reservoir or the water kiosks were required, and which these infrastructures would be sited were assessed. The households were asked on their knowledge and perception of general land ownership within the locality. Such would include

ownership of land in which the borehole and other infrastructures, including the kiosks, where they were established and conditions under which the land was given.

The results showed that 55.0% of the households reported the land tenure (document) of ownership was the title deeds for individuals. This implied other forms of land ownership only accounted for 45%. For instance, it was perceived National Government ownership was 16.3%; and perception of County government land ownership was only 12.2%. However, 12.8% of responding households were un-aware which type of ownership actually existed. A paltry 1.7% was perceived by the households to be community Trust land, while 1.5% as that acquired through allotment letters.

The ownership of land on which the boreholes were established, 40.4% of households, perceived it to be for National government, another 33.5% perceived as belonging to County Government while community public land accounted for 12.6%. Only 2.0% of households perceived the boreholes were established on individual land, while 11.5% instead cited other ownership types. As to ownership of land on which water kiosk were established, 44.8% of responding households perceived kiosks were established on individual land. On the contrary, 19.6% cited County Government land while 18.6% National Government land. However, 0.9% of households perceived that the water kiosk were established on community public land while other forms of ownership accounted for 16.1%. Unless, the documentation for ownership were properly and carefully designed, the community would easily be disinherited from accessing or managing the borehole water kiosks established on individual land parcels. Some of these findings are provided in Table 4.21.

ST. PAUL'S UNIVERSITY

Table 4.18: Land Ownership Influencing Sustainability of Borehole and Water Kiosks

Characteristics	Frequency	Percent
Living within the area to benefit?		
No	171	37.2%
Yes	289	62.8%
Who owns the land where the Borehole is established?		
Individual land	9	2.0%
Community public land	58	12.6%
County Gov. land	154	33.5%

National Gov. Land	186	40.4%
Others ownerships	53	11.5%
Who owns the land where the kiosk is established?		
Individual land	206	44.8%
Community public land	4	0.9%
County Gov. land	90	19.6%
National Gov. Land	86	28.7%
Others ownerships	74	16.1%

It was assumed land for establishing the borehole or water kiosk could have been given under certain conditions. As to which conditions the land was handed over before establishment of the water kiosk, 95.7% of responding households reported no such conditions were given. This finding was corroborated by FDGs, which also indicated that when a community project such as water borehole or kiosk was identified as suited for siting at a member's land; the household whose land was identified would voluntarily give it out for the community good.

> *... The farm owners also never want to take responsibility claiming that the pipes should have been laid deeper than that. We end up bearing the cost of repairs.* (Female Operator 4, Seme FGD)

In other responses, 2.3% of the households reported that the owner of the land on which the water kiosk was to be built was to be paid; while 2.0% indicated the household of land owner would be exempted from payments for water services once water kiosk had been established. While allowing those who had given land free access to water service, it was not possible to ascertain whether the owners of the land who were to be paid were actually paid. Both aspects were not included into this study. However, such posed a possible risk for the water committee and goodwill for the donating household or willingness to provide space for additional projects.

ST. PAUL'S UNIVERSITY

4.10.2 Association of Land Ownership with Financial Sustainability of Water Kiosks

Regarding the question of satisfaction with the kiosk's location, 96.1% of respondents reported being satisfied, while 3.9% expressed dissatisfaction. When comparing these satisfaction levels with low and high financial sustainability, it appears that those who are satisfied are slightly more likely to have high financial sustainability (37.3%) compared to those who are dissatisfied (33.3%). However, the p-value associated with this comparison is 0.731, which is higher than the

significance level of 0.1. This suggests that the level of satisfaction with the kiosk's location is not statistically associated with financial sustainability. Table 4.22 provides the association between the moderating factors with the financial sustainability of water kiosks.

Table 4.19: Association of Land Ownership and Financial Sustainability

Moderating variable	Response	Overall Percentage	Financial Sustainability of water kiosk services		P-value
			Low	High	
Satisfaction with kiosk site location					0.731
	Dissatisfied	3.9%	66.7%	33.3%	
	Satisfied	96.1%	62.7%	37.3%	
HH living within the area to benefit					0.266
	No	37.2%	66.1%	33.9%	
	Yes	62.8%	60.9%	39.1%	
Who owns the land where the borehole is established?					0.001
	Individual land	2.0%	55.6%	44.4%	
	Community public land	12.6%	81.0%	19.0%	
	County government land	33.5%	49.4%	50.6%	
	National government land	40.4%	66.1%	33.9%	
	Others	11.5%	71.7%	28.3%	
Who owns the land where the kiosk is established?					0.002
	Individual land	44.8%	61.2%	38.8%	
	Community public land	0.9%	75.0%	25.0%	
	County government land	19.6%	47.8%	52.2%	
	National government land	18.7%	73.3%	26.7%	
	Others	16.1%	73.0%	27.0%	

In the context of living within the area to benefit, 62.8% of respondents reported living within the area, while 37.2% did not. When comparing these two groups in terms of low and high financial sustainability, it seems that those who live within the area to benefit are slightly more likely to have high financial sustainability (39.1%) compared to those who do not live within the area (33.9%). However, the p-value for this comparison is 0.266, which is higher than the significance level of 0.1. This suggests that living within the area to benefit is not statistically associated with financial sustainability.

The ownership of the land where the borehole was established was diversified across various categories. A small minority, approximately 2.0%, of the boreholes are situated on land that is individually owned. Community public land accounts for about 12.6% of the borehole locations,

ST. PAUL'S UNIVERSITY

indicating a communal ownership arrangement. A significant portion, around 33.5%, of the boreholes was established on land owned by the county government. The majority of the boreholes, roughly 40.4%, are located on land owned by the national government, signifying a significant presence of government-owned land in the context of borehole infrastructure. Additionally, about 11.5% of the boreholes fall under the category of "Others," which may encompass various forms of ownership or unique land arrangements that were not specified in the provided data. This diverse distribution of land ownership reflects the complex landscape within which borehole water sources were established in the study area. Notably, those who mentioned "county government" as the ownership category had the highest proportion in the high financial sustainability group (50.6%), while those mentioning "community public land" had the lowest proportion in the high financial sustainability group (19.0%). The p-value for this comparison is 0.001, which is below the significance level of 0.1. This indicates a statistically significant association between land ownership where the borehole was established and financial sustainability. Specifically, boreholes situated on county government land tend to have higher financial sustainability compared to the rest.

Similarly, results show that the majority of the kiosks (44.8%) were located on land classified as "Individual land." A very small percentage (0.9%) of kiosks is established on "Community public land." Additionally, 19.6% of kiosks are situated on "County government land," while 18.7% are on "National government land." Another category labelled as "Other" accounts for 16.1% of kiosks. Among kiosks on "Individual land," a higher proportion (61.2%) is associated with low financial sustainability, while 38.8% are linked to high financial sustainability. For the extremely limited number of kiosks on "Community public land," 75.0% exhibit low financial sustainability, while 25.0% demonstrate high financial sustainability. On "County government land," 47.8% of kiosks have low financial sustainability, whereas a greater proportion (52.2%) displays high financial sustainability. For kiosks on "National government land," a significant majority (73.3%) experience low financial sustainability, with only 26.7% having high financial sustainability. In the "Others" category, 73.0% of kiosks have low financial sustainability, while 27.0% exhibit high financial sustainability. The p-value associated with this analysis is 0.002, which indicates statistical significance at the 0.1 level. This suggests that the ownership of land

ST. PAUL'S UNIVERSITY

where the kiosk is established has a significant influence on the financial sustainability of water kiosk services, with variations observed among different land ownership categories.

4.10.3 Influence of Land Ownership with Financial Sustainability of Water Kiosks

The analysis revealed that satisfaction with the location of the kiosk site does not have a statistically significant influence on financial sustainability. The odds ratio of 1.29 suggests that those who were satisfied with the kiosk's location are 1.29 times more likely to have high financial sustainability compared to those who are dissatisfied. However, this difference is not statistically significant, as indicated by the p-value of 0.622. Similarly, whether households live within the area to benefit from the kiosk services does not seem to significantly impact financial sustainability. The odds ratio of 1.34 indicates that those living within the area are 1.34 times more likely to have high financial sustainability than those who do not live within the area. However, this result is not statistically significant, as reflected by the p-value of 0.178. The findings have been presented in Table 4.23.

ST. PAUL'S UNIVERSITY

Table 4.20: Influence of Land Ownership on Financial Sustainability

Predictor	B	SE	Odds ratio	P-value
Satisfaction with kiosk site location				
(Dissatisfied)				
Satisfied	0.26	0.52	1.29	0.622
HH living within the area to benefit				
(No)				
Yes	0.29	0.22	1.34	0.178
Who owns the land where the borehole is established?				
(Community public land)				
County government land	1.31	0.41	3.70	0.002
Individual land	1.18	0.76	3.25	0.119
National government land	0.99	0.39	2.70	0.012
Others	0.72	0.51	2.06	0.157
Who owns the land where the kiosk is established?				
(Community public land)				
County government land	0.80	1.22	2.23	0.513
Individual land	0.49	1.18	1.63	0.678
National government land	-0.02	1.20	0.98	0.990
Others	0.28	1.23	1.33	0.818

*Note. Estimates represent the log odds of "Financial Sustainability = High" vs. "Financial Sustainability = Low"
*Reference Categories in Brackets

On the other hand, ownership of the land where the borehole was established demonstrated a statistically significant influence on financial sustainability. Kiosks located on County Government land have a substantial odds ratio of 3.70, indicating that they are 3.70 times more likely to have high financial sustainability compared to those on community public land (the reference category). Water kiosks located on national government land also exhibited a significant odds ratio of 2.70, implying that they are 2.70 times more likely to have high financial sustainability compared to community public land. However, kiosks on individual land, with an odds ratio of 3.25, do not show statistical significance (p-value of 0.119). Similarly, water kiosks located on land categorized as "Others" did not demonstrate a statistically significant difference in financial sustainability, with an odds ratio of 2.06 and a p-value of 0.157.

Regarding the ownership of the land where the kiosk is established, none of the ownership categories show a statistically significant impact on financial sustainability. Kiosks on county government land, individual land, national government land, and land categorized as "Others" do not exhibit significant differences in financial sustainability, as indicated by their respective odds ratios and p-values.

ST. PAUL'S UNIVERSITY

4.11 Chapter Summary

This chapter was meant to unfold the results of this inquiry and their interpretation. Its initial section elucidates on the influence of various households' characteristics on financial sustainability of water kiosk services. It was shown that the borehole kiosk is the chief source of drinking water in the community and users who primarily relied on borehole kiosk water for drinking contributed to a higher financial sustainability than those who did not. However, regardless of their choice of main source of drinking water, users have similar odds of supporting high financial sustainability of the kiosk service. While the frequency of fetching water from the borehole kiosk had no effect on financial sustainability of the kiosk, user satisfaction with the quality of kiosk water was a significant. Additionally, shorter waiting times appeared to be crucial for high financial sustainability. On the subject of user household sense of ownership and

financial sustainability of the water kiosk services, a majority of users do not pay membership fees, and are therefore not committed to the service's maintenance and improvement. Most of the respondents believed that the water was community-owned, while a few strongly believed in village people ownership. These perceptions are insignificant, since ownership of the water systems may not always translate into tangible financial support. Concerning the significance of technical factors, it was demonstrated that efficient water usage due to lower pressure contributes to cost savings, hence higher financial sustainability. Over and above that, the year of establishment of the kiosk, its functional state and operating hours have no significant impact. Besides, the kiosks with technicians have higher financial sustainability compared to those without, as disruptions in the water flow are controlled. With regard to participation of the user households, the analysis indicates that it is significant, especially with regards to the contributions towards the establishment of the water systems. Notwithstanding, having a household member involved in management and attendance or non-attendance of meetings have no significant impact. Other findings which were not statistically tested reveal that kiosk operators have several challenges who fail to pay for the water. Furthermore, as to ownership of land on which water kiosks were established, the community risks disinheritance of those established on individual land, and failure to pay land owners risked their willingness to provide space for additional projects. In conclusion, satisfaction with the kiosk's location was not statistically associated with its financial sustainability.

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

CHAPTER FIVE

DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Chapter Introduction

This concluding chapter lays out a discussion and synthesis of the findings resulting from this study. This is done in respect to the specific questions that the study set out to address. In addition, the chapter foregrounds the study's input in the field of development studies. It also presents various policy recommendations which may improve the financial sustainability of the community-managed borehole water kiosks and also ensure more streamlined running of water kiosk services in Kisumu County. Its concluding part accentuates opportunities for future inquiries on water security especially in regions within Sub-Saharan countries, where water is a scarce commodity.

5.2 Discussions of Study Results

The high proportion of poor access of the improved water services occasioned by the infrastructure intensive requirements for establishing water kiosks for communities in rural areas coupled with the frequent breakdown of such facilities are challenges that reverse the gains made against the deaths attributable to water. This study examined the influence of user households' characteristics, borehole water kiosk technical design factors and governance factors on financial sustainability of community-managed borehole (CM-BH) water kiosk services within Kisumu County in Kenya. This section discusses the findings, comparing and contrasting with other previous studies, where available as well as presenting the implications of such findings.

ST. PAUL'S UNIVERSITY

5.2.1 Socio-Demographic Characteristics and Financial Sustainability of Kiosk Services

Majority of the household heads who responded to the questionnaires were men and the mean age of the household heads was shown to be 49 years (± 14 years). Most households had 42% females and 58% males, a finding which mirrored that of a different study which also found about 41% and 59% females and males respectively (Omondi et al., 2019). This finding confirms

the patriarchal nature of the households within the Kisumu County, and in general, majority of the Luo community living with the region.

The study showed that over 79% of households paid for their water but the payments varied from one borehole location to another, and a 20-litres jerrican remaining the main container of fetching water. Through the FGDs and KII, the tariff for the 20-litre jerrican ranged between KES 2.50 to 5.00. Comparing this tariff to that in a previous study showed that the average price for a 20-litre jerrican was KES 3.01 in the urban informal settlements of Kisumu in 2017 (Nzengya, 2018b). This finding suggests that the pricing of community-managed water service seemed to have remained fairly constant within a period of 7 years, despite the economic changes, thus having implications for kiosks to attain financial sustainability.

The study showed that over 65% of households used 20-litre or less jerricans to store their water in the house and about 33% used larger containers for storage. In another study in Sodo Zuria District of rural Ethiopia, it was revealed that around 45% of the households used 20-litre or less jerricans to store their water while around 45% stored their water in containers larger than 20-litre jerricans (Admasie et al., 2022). The size of the containers used in fetching, transporting and storage of water at home has a bearing on the financial sustainability of community managed borehole water kiosks. If the size of the container for fetching water is the same as that for storage, it implies that the user household must wait until the collected water is used. However, if they are different, and the storage is larger, the user can make more than one trip and must not wait until the water is exhausted before making a trip to the borehole kiosk.

The study showed that over 70% of households fetched water the previous day which was sufficient water for their household needs. This result represented the household consumption, which could either be influenced by factors such as availability of water, distance to and from the water kiosk and satisfaction with the water from the source. Another study had showed that the household consumption and water collection distance were strong determinants that influenced the household water consumption in a day (Basu et al., 2017). Since distance to the water kiosks (rather time taken), was outside the scope of the study, it would be important to look at this

ST. PAUL'S UNIVERSITY

aspect in future studies. Further, an inquiry into why almost 30% of the households did not have sufficient water for their needs would be relevant to explore.

5.2.2 User Households' Characteristics and Financial Sustainability

The user households' satisfaction with the borehole water kiosk as the source of the drinking water was 89%. This compared closely with findings of another study which showed 63% satisfaction by borehole kiosk users in Kyuso, a semi-arid area in Eastern Kenya (Goodall et al., 2016). Additionally, users who primarily relied on borehole kiosk water for drinking contributed to a higher financial sustainability than those who did not. User satisfaction with the quality of kiosk water emerged as a significant predictor of financial sustainability in this study, with those expressing satisfaction with the water they obtained from the borehole water kiosks more likely to support high financial sustainability. Moreover, users who were satisfied with the water quality have 3.46 times higher odds of supporting high financial sustainability compared to users who were dissatisfied. Ensuring water quality that meets users' satisfaction is crucial for financial sustainability.

The results showed that taking a shorter duration (below 10 minutes) to fetch water had a positive significant influence and between 10-19 minutes had marginal positive significant influence on the financial sustainability of community-managed borehole water kiosks. In one other study, it was revealed that when the time for fetching water was reduced the available time could now be used for other productive activities (such as gardening) or other socio-economic responsibilities (more time on household chores, working more outside the home, among others) (Winter et al., 2021). In another study, the time spent on water collection was found to be inversely related to the household water consumption (Basu et al., 2017). Thus, when time for water collection was reduced, it most likely implies that the user household might make more trips to get the service as opposed to those who spend more time to the water kiosk. As observed by the previous study, high collection time limits the volume of water used by limiting the number of trips the household is likely to make for fetching water. The frequent trips to the water kiosk with reduced time translates to more revenue for the water kiosk.

ST. PAUL'S UNIVERSITY

Seasonal patterns in water kiosk use were evident among user households, indicating consistent, or otherwise, of reliance on the kiosk throughout the year. This is well established in many previous works (Akelo & Nzengya, 2021; Thomson et al., 2019; Kelly et al., 2018). Seasonality affected the ability of the water committee to carry out their required activities; while also reducing the number of visits by users to the borehole kiosks during rainy seasons; and less user community participation during such rainy seasons (Kelly et al., 2018). However, this study has been able to quantify and develop indices for the low and high seasonality season, with which it showed that seasonality in household water kiosk use was significantly related to financial sustainability ($\chi 2 = 0.001$, $p < 0.05$). As well, the seasonality in household water kiosk use was a robust predictor of financial sustainability with users who experienced high seasonality being markedly more likely to contribute to high financial sustainability (odds ratio = 11.20, $p < 0.001$). In another work, using the seasonal revenue at community-managed water kiosks, it was described as seasonal peaks and drops (Akelo & Nzengya, 2021). Thus, understanding and adapting to these seasonal usage patterns is essential in maintaining high financial sustainability in the community-managed borehole water kiosks.

5.2.3 User Households' Sense of Ownership and Financial Sustainability

A substantial majority (about 87%) of user households did not pay these fees, suggesting that a significant portion of user households was not financially contributing to the operation of the borehole water kiosk services. Users who chose to pay membership fees were notably more likely to be associated with a high level of financial sustainability, as opposed to the users who did not pay membership fees, who were associated with a low level of financial sustainability. Payment for membership fees is also seen as a way of users' involvement in the project. This supported the earlier finding which had observed that community members involvement could be noted in roles such as contribution of resources (Nyakwaka & Benard, 2019c). These findings suggest that financial contributions from users, in the form of membership fees, play a critical role in strengthening the financial sustainability of water kiosk services because they are likely to have a vested interest in the borehole kiosk's well-being.

ST. PAUL'S UNIVERSITY

With regard to the belief that the water system is owned by people in the village, the responses are less skewed in distribution. While 65.2% of respondents strongly believe that the water system is owned by individuals in their village, users who strongly believed that the water system was owned by people in the village were more likely to be associated with a low level of financial sustainability. In another study, however, users' confidence and system management were positively associated with households' sense of ownership, all else held constant (Marks et al., 2013b). Conversely, among users who do not believe at all that the water system was owned by people in the village, 50.0% are associated with a low level of financial sustainability. These intriguing results suggest that strong beliefs in village people owning the borehole water kiosk may negatively affect the financial sustainability of water kiosk services, by restricting the number of users or the volume of consumption from outside the village. Nonetheless, the village ownership provides the community-managed water kiosk a specific geographical boundary of catchment for planning purposes.

5.2.4 Water Kiosk Technical Designs and Financial Sustainability

The data indicated that the perception of water pressure from the borehole kiosk varies among users, with users who reported experiencing low water pressure more likely to have high financial sustainability (52.8%) compared to those with moderate (32.0%) or high (40.1%) water pressure. The previous studies in these areas looked at the volume discharged from the kiosks (Sima et al., 2013), rather than the pressure of discharge. This study has revealed that water pressure has a statistically significant association with the financial sustainability of kiosk services ($p = 0.011$); a finding that suggests that efficient water usage due to lower pressure might potentially contribute to cost-savings, leading to higher financial sustainability.

The study revealed the critical role and significant association on the presence of a kiosk technician or plumber with its financial sustainability. This compares with the earlier findings that community management of relatively complex piped system delivering household water supplies (and community water supplies) require payment of paid staff such as plumbers (Moriarty et al., 2013). While the referred study had established that hired staff was on salaries, the findings from the current study showed that many water committees only paid the technicians

ST. PAUL'S UNIVERSITY

and plumbers based on the work done. Most of the studied boreholes and water kiosks would not be able, from own revenue and work requirement, to sustain monthly pays.

5.2.5 Water Kiosk Governance, Participation and Financial Sustainability

Among the respondents, about half reported that they did not know committee members, with those not knowing committee members having low financial sustainability. Knowledge of the committee, from experience, is either through participating in their elections, attending meeting with the users, or frequently fetching water from one of the kiosks the committee members are in charge. Hence, as the study revealed, among those who knew committee members, a substantial 70.3% were in the high financial sustainability group. This indicates a significant association between knowing committee members and higher financial sustainability, as evidenced by a p-value of 0.001.

The frequency of management committee meetings showed varied effects on financial sustainability. Respondents who reported to meetings "once every 6 months" were associated with significantly lower odds of achieving high financial sustainability. A previous study had indicated that access to drinking water could be improved through addressing certain water governance challenges such as monitoring and enforcement of water quality policies, sufficient capacity for administrative and technical management (Huang et al., 2020). The frequency of the committee meetings is vital for the committee to regularly receive, review and discuss matters of performance of their water system.

Majority of households (89.3%) did not contribute towards the establishment of the kiosk or water service and were thus significantly more likely to contribute to low levels of financial sustainability. In contrast, households that contributed to the establishment of the kiosk demonstrated a strong and statistically significant association with high financial sustainability.

ST. PAUL'S UNIVERSITY

5.2.6 Water Kiosk Land Ownership and Financial Sustainability

The ownership of the land where the borehole is established is diversified across various categories. Majority of the households reported that the water boreholes were established on national or county government and community public lands. There was a statistically significant association between land ownership where the borehole was established and financial sustainability. In an earlier study, community member involvement in projects was noted in roles such as contribution of resources and location of facilities, among others (Nyakwaka & Benard, 2019c). Specifically, boreholes situated on county government land tend to have higher financial sustainability compared to the rest.

Other studies have also shown the important role the land on which the borehole is located plays (Kimutai et al., 2018). When the borehole was established on private land, the community may not control the individual owning the land such as in the construction of pit latrines. While most community members have consensus when the water facility was being established on an individual's land, such agreement may not hold in the face of inheritance from the next generation. That notwithstanding, this study provides evidence on how influential the ownership of the land on which the borehole was established was on the financial sustainability of the community-managed borehole water kiosk. Thus, the strong influence of the borehole being on the national government's or county government's land on financial sustainability is because they are fenced off and no disinheritance may suffice.

5.3 Conclusions of the Study

The research had six objectives. The first objective was: "To analyze the influence of water kiosk user household characteristics on financial sustainability of borehole water kiosk services." The study revealed that there was statistically significant association between satisfaction with kiosk water for drinking and financial sustainability of community managed borehole water kiosks. Other significant associations were also showed for the time taken to fetch water from the water kiosks and seasonal household use of water from water kiosks. As well, there was positive influence of the three predictors (satisfaction with kiosk water for drinking, time taken to fetch

ST. PAUL'S UNIVERSITY

water, and seasonal use of water kiosks) on the financial sustainability of the community-managed water kiosks.

The second objective was: "To assess the influence of user households' sense of ownership on the financial sustainability of community-managed borehole water kiosk services" The study showed that there was statistically significant association between financial sustainability of community-managed water kiosks with payment for membership and village people owning the water kiosks. In addition, most of the respondents believe that the water was community-owned, while a few strongly believe in village people ownership. Nonetheless, these perceptions were insignificant, since ownership of the water systems may not always translate into tangible financial support.

The third objective was: "To analyze the influence of water kiosks' technical design and layout on the financial sustainability of community-managed borehole water kiosk services" The study revealed that there was statistically significant association between the pressure with which the borehole kiosk discharged the water and the financial sustainability of the community-managed borehole kiosks. Other associations included the year of establishment of the kiosk, the availability of a technician or plumber and duration of the kiosk remaining open. The kiosks with technicians have higher financial sustainability compared to those without, as disruptions in the water flow are controlled. The year of establishment of the kiosk, its functional state and operating hours have no significant impact on the financial sustainability of community-managed water kiosk services.

The fourth objective was: "To examine the influence of borehole water committee governance on the financial sustainability of community-managed borehole water kiosk services." The study showed that there was statistically significant association between user households knowing the committee members and financial sustainability of the community-managed borehole water kiosk services. However, there were statistically significant influences on the negative direction, of user household perceptions of water committee members and the frequency of committee meetings on the financial sustainability of the community-managed borehole kiosk services.

ST. PAUL'S UNIVERSITY

The fifth objective was: "To assess the influence of the user household participation in governance on financial sustainability of community-managed borehole water kiosk services" It was revealed that there was a statistically significant association between the user households contributing towards the water kiosk establishment and the financial sustainability of the water kiosk services. Moreover, having a household member being involved in management does not appear to significantly impact financial sustainability of the borehole kiosk.

The final objective was: "To examine the significance of land ownership in moderating the influence of the user household characteristics, technical designing and governance factors on the financial sustainability of community-managed borehole water kiosk services" The study showed that there were statistically significant associations between the ownership of the land where the borehole is located, on one hand, and the ownership of land where the water kiosk is located, on the other, with the financial sustainability of the water kiosk services. As well, the study revealed that there was a statistically significant influence on a positive direction, of the ownership of land where the borehole is located on financial sustainability of the water kiosk services.

ST. PAUL'S UNIVERSITY

5.4 Contribution of the Study to Knowledge

The seasonality of household water use from the water sources and the impacts this might have on the sustainability of the water sources has been studied. Qualitative discussions of such impacts or time series of the revenues with peaks and drops are available in literature. However, this study explored the frequency of seasonal household use (in rainy and dry) seasons. With the help of the principal component analysis (PCA), the study developed seasonality indices of low and high seasonality, which can now be used to predict the seasonality of the household water kiosk use.

Most, if not all, the previous studies on the sustainability of water sources have generated their data from households' users, water committees and the water officers. This study provided an opportunity to the water kiosk operators, user households, water committees and water officers to speak on the financial sustainability of the community-managed borehole water kiosks. It has

therefore contributed to new knowledge by giving a voice to the silent stakeholders of water kiosk sustainability; that is, the kiosk operators, attendants or salespersons.

The available studies on community participation and community sense of ownership are varied and numerous. This study also considered the community sense of ownership and the sense of ownership by people living in the village. Therefore, having the user household perceiving that the sense of ownership by the people of the village influences the financial sustainability of the community-managed borehole water kiosks is a new contribution to knowledge.

Most of the community's contribution to the water projects includes the land on which the project will be sited. This might be community public land, government (national or county level) or individual land. Current literature has documented different possible impacts on ownership of land. However, this study has shown strong association between the ownership the land where a borehole or a water kiosk is sited and the financial sustainability of community-managed borehole water kiosk services.

5.5 Study Recommendations

5.5.1 Recommendations for Policy

Several policy implications have emanated from the findings of this study. The findings related to the first objective show that the borehole kiosk is the chief source of drinking water in the community under investigation. Therefore, the Kenyan Government and the County Government of Kisumu need to invest in water harvesting in this county to ensure water security for the residents. The investments may include sand dams that can be set in areas where we have boreholes to ensure that associated aquifers supply plenty of water to the community. Such an investment will go a long way reducing waiting time during the fetching of water as shorter waiting times appeared to be crucial for high financial sustainability.

Based on the third objective on the influence of technical factors on financial sustainability of borehole water kiosk services, it was showed that the kiosks with technicians have higher financial sustainability compared to those without, as disruptions in the water flow are

ST. PAUL'S UNIVERSITY

controlled. Additionally, repairs of broken down equipment take time and other equipment are never repaired. Therefore, it would be necessary to have technicians, plumber operators, attendants or salespersons that are appropriately remunerated for the boreholes and water kiosks so that there is someone responsible and caring for use of the water point.

It is also recommended that development partners consider re-training additional skill-sets amongst local community members, operators, technicians and water committees in relevant areas for effective and efficient performance. This will also ensure that broken down equipment do not fail to be repaired or take long before being repaired.

Subject to the sixth objective on moderating factors and their effect on financial sustainability of borehole water kiosk services, this study found out that the community risked disinheritance of boreholes and kiosks established on individual land whose owners were not paid or gave land for the projects and proper documentation of the process. It is therefore recommended that the water committees in place should engage with the affected individual land owners, government offices and ministry of land officials to regularize such allocated land into the community ownership for the facilities (borehole or kiosk) that are located on individual land.

5.5.2 Recommendations for Future Research

Sustainability has been noted to be a multidimensional concept, with functionality, financial, social and environmental paradigms. This study focused on the financial sustainability of the community-managed borehole water kiosks. There is need to explore the same issue further on other dimensions including functionality, inclusivity and equity, environmental and health.

It would be consequential to identify water kiosks that function with no operators and compare their functionality with those that have operators. Such a comparative study would have significant implications in terms of reducing the human resource required to man water kiosks. Aside from that, investigating specific in-kind contributions most appropriate for both giver as well as the management of the water system and comparing the performance of boreholes with and without water committees as well as exploring governance systems, institutional-

ST. PAUL'S UNIVERSITY

community-based management would be influential in the demonstration of higher levels of effectiveness and sustainability of such water systems.

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

REFERENCES

Acharya, K. K. (2016). Determinants of community governance for effective basic service delivery in Nepal. *Dhaulagiri Journal of Sociology and Anthropology*, *10*.

Adams, A. (2012). *Financial sustainability of rural water supplies in Western Kenya: Comparing technology types and management models*.

Adamson, D., Bere, J., Bevan, J., Isherwood, N., MacNamara, H., & Southall, A. (2014). A Guide to Effective Community Engagement. *Regeneration Wale Adfywio Cymru*.

Admasie, A., Abera, K., & Feleke, F. W. (2022). Household Water Treatment Practice and Associated Factors in Rural Households of Sodo Zuria District, Southern Ethiopia: Community-Based Cross-Sectional Study. *Environmental Health Insights*, *16*, 11786302221095036. https://doi.org/10.1177/11786302221095036

Akelo, J., & Nzengya, D. (2021). Seasonality, Water Use and Management of Community-Based Water Projects in Urban Slums: Findings from Nairobi's Kayole Slums, Kenya. *Impact: Journal of Transformation*, *4*(1), 96–108. http://41.89.24.4/index.php/impact/article/view/91

Alexander, K. T., Mwaki, A., Adhiambo, D., Cheney-Coker, M., Muga, R., & Freeman, M. C. (2016). The life-cycle costs of school water, sanitation and hygiene access in Kenyan primary schools. *International Journal of Environmental Research and Public Health*, *13*(7), 637.

Amjad, U. Q., Ojomo, E., Downs, K., Cronk, R., & Bartram, J. (2015). Rethinking Sustainability, Scaling Up, and Enabling Environment: A Framework for Their

ST. PAUL'S UNIVERSITY

Implementation in Drinking Water Supply. *Water*, *7*(4), Article 4. https://doi.org/10.3390/w7041497

Ananga, E. O., Njoh, A. J., Anchang, J. Y., & Akiwumi, F. A. (2017). Participation-related factors influencing performance in four urban-based community-operated water schemes in Kisumu, Kenya. *Community Development Journal*, *52*(2), 319–336.

Araral, E., & Wang, Y. (2013). Water Governance 2.0: A Review and Second Generation Research Agenda. *Water Resources Management*, *27*(11), 3945–3957. https://doi.org/10.1007/s11269-013-0389-x

Baek, H., & Lee, H. (2021). Framework of Socio-Technology Analysis and Prescriptions for a sustainable society: Focusing on the mobile technology case. *Technology in Society*, *65*, 101523. https://doi.org/10.1016/j.techsoc.2020.101523

Baerlein, T., Kasymov, U., & Zikos, D. (2015). Self-Governance and Sustainable Common Pool Resource Management in Kyrgyzstan. *Sustainability*, *7*(1), Article 1. https://doi.org/10.3390/su7010496

Baker, K. K., Senesac, R., Sewell, D., Sen Gupta, A., Cumming, O., & Mumma, J. (2018). Fecal Fingerprints of Enteric Pathogen Contamination in Public Environments of Kisumu, Kenya, Associated with Human Sanitation Conditions and Domestic Animals. *Environmental Science & Technology*, *52*(18), 10263–10274. https://doi.org/10.1021/acs.est.8b01528

Bank, W. (2017). Sustainability assessment of rural water service delivery models: Findings of a multi-country review. *Water Global Practice*.

ST. PAUL'S UNIVERSITY

Barlow, M. (2009). *Our Water Commons: Towards a New Freshwater Narrative (West Ottawa, ON: The Council of Canadians)*.

Barnes, A. N., Anderson, J. D., Mumma, J., Mahmud, Z. H., & Cumming, O. (2018). The association between domestic animal presence and ownership and household drinking water contamination among peri-urban communities of Kisumu, Kenya. *PloS One*, *13*(6), e0197587.

Basu, M., Hoshino, S., Hashimoto, S., & DasGupta, R. (2017). Determinants of water consumption: A cross-sectional household study in drought-prone rural India. *International Journal of Disaster Risk Reduction*, *24*, 373–382. https://doi.org/10.1016/j.ijdrr.2017.06.026

Behnke, N. L., Klug, T., Cronk, R., Shields, K. F., Lee, K., Kelly, E. R., Allgood, G., & Bartram, J. (2017). Resource mobilization for community-managed rural water systems: Evidence from Ghana, Kenya, and Zambia. *Journal of Cleaner Production*, *156*, 437–444. https://doi.org/10.1016/j.jclepro.2017.04.016

Bisung, E., & Elliott, S. J. (2014). Toward a social capital based framework for understanding the water-health nexus. *Social Science & Medicine*, *108*, 194–200. https://doi.org/10.1016/j.socscimed.2014.01.042

Biswas, A. K., & Seetharam, K. E. (2008). Achieving Water Security for Asia: ASIAN WATER DEVELOPMENT OUTLOOK, 2007. *International Journal of Water Resources Development*, *24*(1), 145–176. https://doi.org/10.1080/07900620701760556

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

Biswas, A. K., & Tortajada, C. (2010). Future Water Governance: Problems and Perspectives. *International Journal of Water Resources Development*, *26*(2), 129–139. https://doi.org/10.1080/07900627.2010.488853

Blanc, D. L. (2015). Towards Integration at Last? The Sustainable Development Goals as a Network of Targets. *Sustainable Development*, *23*(3), 176–187. https://doi.org/10.1002/sd.1582

Bonett, D. G., & Wright, T. A. (2015). Cronbach's alpha reliability: Interval estimation, hypothesis testing, and sample size planning. *Journal of Organizational Behavior*, *36*(1), 3–15. https://doi.org/10.1002/job.1960

Brink, H. I. L. (1993). Validity and reliability in qualitative research. *Curationis*, *16*(2), Article 2. https://doi.org/10.4102/curationis.v16i2.1396

Butterworth, J., & Juma, I. (2005). *i African Water Laws: Plural Legislative Frameworks for Rural Water Management in Africa*.

Cartelli, A. (2007a). Socio-technical theory and knowledge construction: Towards new pedagogical paradigms? *Issues in Informing Science & Information Technology*, *4*.

Cartelli, A. (2007b). Socio-technical theory and knowledge construction: Towards new pedagogical paradigms? *Issues in Informing Science & Information Technology*, *4*.

Cheevapattananuwong, P., Baldwin, C., Lathouras, A., & Ike, N. (2020). Social Capital in Community Organizing for Land Protection and Food Security. *Land*, *9*(3), Article 3. https://doi.org/10.3390/land9030069

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

Choe, H., & Yun, S.-J. (2017). Revisiting the Concept of Common Pool Resources: Beyond Ostrom. *Development and Society*, *46*(1), 113–129. https://www.jstor.org/stable/90011214

Cleaver, F., & Franks, T. (2007). Water Governance and Poverty: A Framework for Analysis. *Progress in Development Studies*, *7*. https://doi.org/10.1177/146499340700700402

Cleaver, F., & Toner, A. (2006). The evolution of community water governance in Uchira, Tanzania: The implications for equality of access, sustainability and effectiveness. *Natural Resources Forum*, *30*(3), 207–218.

Contzen, N., & Marks, S. J. (2018a). Increasing the regular use of safe water kiosk through collective psychological ownership: A mediation analysis. *Journal of Environmental Psychology*, *57*, 45–52. https://doi.org/10.1016/j.jenvp.2018.06.008

Contzen, N., & Marks, S. J. (2018b). Increasing the regular use of safe water kiosk through collective psychological ownership: A mediation analysis. *Journal of Environmental Psychology*, *57*, 45–52.

Creswell, J. W. (n.d.). *Steps in Conducting a Scholarly Mixed Methods Study*.

Creswell, J. W. (2013). *Steps in conducting a scholarly mixed methods study*.

Dayal, R., Van Wijk, C., & Mukherjee, N. (2000). Methodology for participatory assessments. *With Communities, Institutions and Policy Makers*.

Egbinola, C. N. (2017). Trend in access to safe water supply in Nigeria. *Journal of Environment and Earth Science*, *7*(8), 89–96.

ST. PAUL'S UNIVERSITY

Engler, A., Melo, O., Rodríguez, F., Peñafiel, B., & Jara-Rojas, R. (2021). Governing water resource allocation: Water user association characteristics and the role of the state. *Water*, *13*(17), 2436. https://www.mdpi.com/2073-4441/13/17/2436

Estache, A., & Kouassi, E. (2002a). Sector organization, governance, and the inefficiency of African water utilities. *Governance, and the Inefficiency of African Water Utilities (September 2002)*.

Estache, A., & Kouassi, E. (2002b). Sector organization, governance, and the inefficiency of African water utilities. *Governance, and the Inefficiency of African Water Utilities (September 2002)*.

Foster, T. (2016). *From cash flows to water flows: An assessment of financial risks to rural water supply sustainability in sub-Saharan Africa* [PhD Thesis]. University of Oxford.

Foster, T., & Hope, R. (2017). Evaluating waterpoint sustainability and access implications of revenue collection approaches in rural K enya. *Water Resources Research*, *53*(2), 1473–1490.

Gilgun, J. F. (n.d.). Designing qualitative social work research. *Sage Handbook of Qualitative Research Design. Sage Publication*. Retrieved September 29, 2023, from https://www.researchgate.net/profile/Jane-Gilgun/publication/353338229_Designing_Qualitative_Social_Work_Research/links/60f573c20859317dbdf36848/Designing-Qualitative-Social-Work-Research

Gilgun, J. F. (2014). Social work specific research and theory building. *Manuscript Submitted for Publication in International Encyclopedia of Social and Behavioral Sciences, James Wright (Ed). New York: Elsevier*.

ST. PAUL'S UNIVERSITY

https://www.researchgate.net/profile/Jane-Gilgun/publication/322580475_Social_Work_Specific_Research_and_Theory_Building/links/5a60d6c50f7e9bfbc3f8f20e/Social-Work-Specific-Research-and-Theory-Building

Gomez, M., Perdiguero, J., & Sanz, A. (2019). Socioeconomic Factors Affecting Water Access in Rural Areas of Low and Middle Income Countries. *Water*, *11*(2), Article 2. https://doi.org/10.3390/w11020202

Goodall, S., Hope, R., & Katilu, A. (2016). *Operational, financial and institutional considerations for rural water services: Insights from Kyuso, Kenya*. https://repository.lboro.ac.uk/articles/conference_contribution/Operational_financial_and_institutional_considerations_for_rural_water_services_insights_from_Kyuso_Kenya/9594617/1

Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a Conceptual Framework for Mixed-Method Evaluation Designs. *Educational Evaluation and Policy Analysis*, *11*(3), 255–274. https://doi.org/10.3102/01623737011003255

Hall, D., & Lobina, E. (2004). Private and Public Interests in Water and Energy. *Natural Resources Forum*, *28*, 268–277. https://doi.org/10.1111/j.1477-8947.2004.00100.x

Hamlet, L. C., Mwiti Kamui, M., & Kaminsky, J. (2020). Infrastructure for water security: Coping with risks in rural Kenya. *Journal of Water, Sanitation and Hygiene for Development*, *10*(3), 481–489. https://doi.org/10.2166/washdev.2020.038

Hodgkin, A. (1994). *Chance and design: Reminiscences of science in peace and war*. Cambridge University Press.

ST. PAUL'S UNIVERSITY

Huang, W. W., Chen, X. J., Fan, Y. R., & Li, Y. P. (2020). *Management of Drinking Water Source in Rural Communities under Climate Change*. https://doi.org/10.3808/jei.202000431

Hughes, J. A., & Sharrock, W. W. (2016). *The philosophy of social research*. Routledge.

Ibrahim, S. (2017). *Sustainability Assessment and Identification of Determinants in Community-Based Water Supply Projects using Partial Least Squares Path Model*. https://doi.org/10.13044/J.SDEWES.D5.0153

Jiménez, A., & Pérez-Foguet, A. (2010). Challenges for Water Governance in Rural Water Supply: Lessons Learned from Tanzania. *International Journal of Water Resources Development*, *26*(2), 235–248. https://doi.org/10.1080/07900621003775763

Kabote, S. J., & John, P. (2017). *Water governance in Tanzania: Performance of governance structures and institutions*.

Kamuti, R. K. (2013). *Challenges of Implementing Strategic Change at National Water Conservation and Pipeline Corporation, Kenya* [PhD Thesis]. University of Nairobi.

Kanoti, J. R., Olago, D., Opiyo, N., & Nyamai, C. (2019). *An overview of groundwater and sanitation challenges in Kisumu City, Kenya*.

Katz, T., & Sara, J. (1997). *Making rural water supply sustainable: Recommendations from a global study*. The World Bank.

Kaushik, V., & Walsh, C. A. (2019). Pragmatism as a research paradigm and its implications for social work research. *Social Sciences*, *8*(9), 255.

Kelly, E., Lee, K., Shields, K. F., Cronk, R., Behnke, N., Klug, T., & Bartram, J. (2017). The role of social capital and sense of ownership in rural community-managed water systems:

ST. PAUL'S UNIVERSITY

Qualitative evidence from Ghana, Kenya, and Zambia. *Journal of Rural Studies*, *56*, 156–166. https://doi.org/10.1016/j.jrurstud.2017.08.021

Kelly, E., Shields, K. F., Cronk, R., Lee, K., Behnke, N., Klug, T., & Bartram, J. (2018). Seasonality, water use and community management of water systems in rural settings: Qualitative evidence from Ghana, Kenya, and Zambia. *Science of The Total Environment*, *628–629*, 715–721. https://doi.org/10.1016/j.scitotenv.2018.02.045

Kemerink, J., Munyao, S., Schwartz, K., Ahlers, R., & van der Zaag, P. (2016). Why infrastructure still matters: Unravelling water reform processes in an uneven waterscape in rural Kenya. *International Journal of the Commons*, *10*(2).

Kenya, L. O. (2013). *The constitution of Kenya: 2010*. Chief Registrar of the Judiciary.

Kenya, G. of. (1999). *Sessional Paper No. 1 of 1999 on National Policy on Water Resources Management and Development.* Government Printer Nairobi, Kenya.

Khalifa, M., & Bidaisee, S. (2018). The importance of clean water. *Sch J Appl Sci Res*, *1*(7), 17–20.

Kilonzo, R., & George, V. (2017). Sustainability of Community Based Water Projects: Dynamics of Actors' Power Relations. *Journal of Sustainable Development*, *10*, 79. https://doi.org/10.5539/jsd.v10n6p79

Kimutai, J. C., Evans, W. O., & Ekai, P. (2018). Assessment of water shortages and coping measures at household level in the informal settlements of Eldoret Municipality, Uasin Gishu County, Kenya. *IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)*, *12*(3), 57–71. https://www.academia.edu/download/56816169/H1203035771.pdf

ST. PAUL'S UNIVERSITY

Kivunja, C., & Kuyini, A. B. (2017). Understanding and applying research paradigms in educational contexts. *International Journal of Higher Education*, *6*(5), 26–41.

Koehler, J., Rayner, S., Katuva, J., Thomson, P., & Hope, R. (2018). A cultural theory of drinking water risks, values and institutional change. *Global Environmental Change*, *50*, 268–277.

Lannier, A. L., & Porcher, S. (2014). Efficiency in the public and private French water utilities: Prospects for benchmarking. *Applied Economics*, *46*(5), 556–572. https://doi.org/10.1080/00036846.2013.857002

Lennox, L. (2018). *Navigating the sustainability landscape: A systematic review of sustainability approaches in healthcare*. 17.

Machado, A. V., dos Santos, J. A., Quindeler, N. da S., & Alves, L. M. (2019). Critical factors for the success of rural water supply services in Brazil. *Water*, *11*(10), 2180. https://www.mdpi.com/2073-4441/11/10/2180

Marks, D., Winstral, A., Reba, M., Pomeroy, J., & Kumar, M. (2013). An evaluation of methods for determining during-storm precipitation phase and the rain/snow transition elevation at the surface in a mountain basin. *Advances in Water Resources*, *55*, 98–110. https://doi.org/10.1016/j.advwatres.2012.11.012

Marks, S. J. (2012). *Water System Sustainability in Rural Sub-Saharan Africa: Participation, Sense of Ownership, and Performance*. Stanford University.

Marks, S. J., Onda, K., & Davis, J. (2013a). Does sense of ownership matter for rural water system sustainability? Evidence from Kenya. *Journal of Water, Sanitation and Hygiene for Development*, *3*(2), 122–133. https://doi.org/10.2166/washdev.2013.098

ST. PAUL'S UNIVERSITY

Marks, S. J., Onda, K., & Davis, J. (2013b). Does sense of ownership matter for rural water system sustainability? Evidence from Kenya. *Journal of Water, Sanitation and Hygiene for Development*, *3*(2), 122–133. https://doi.org/10.2166/washdev.2013.098

Masduqi, A., Endah, N., Soedjono, E. S., & Hadi, W. (2010). Structural equation modeling for assessing of the sustainability of rural water supply systems. *Water Supply*, *10*(5), 815–823. https://doi.org/10.2166/ws.2010.339

McDonald, D. A. (2016). The weight of water: Benchmarking for public water services. *Environment and Planning A: Economy and Space*, *48*(11), 2181–2200. https://doi.org/10.1177/0308518X16654913

Meadows, D., Randers, J., & Meadows, D. (2004). A synopsis: Limits to growth: The 30-year update. *Estados Unidos: Chelsea Green Publishing Company*.

Meyer, K. E., Van Witteloostuijn, A., & Beugelsdijk, S. (2017). What's in a p? Reassessing best practices for conducting and reporting hypothesis-testing research. *Journal of International Business Studies*, *48*(5), 535–551. https://doi.org/10.1057/s41267-017-0078-8

Mgoba, S. A., & Kabote, S. J. (2020). Effectiveness of participatory monitoring and evaluation on achievement of community-based water projects in Tanzania. *Applied Water Science*, *10*(8), 200. https://doi.org/10.1007/s13201-020-01273-5

Montgomery, M. A., Bartram, J., & Elimelech, M. (2009). Increasing Functional Sustainability of Water and Sanitation Supplies in Rural Sub-Saharan Africa. *Environmental Engineering Science*, *26*(5), 1017–1023. https://doi.org/10.1089/ees.2008.0388

ST. PAUL'S UNIVERSITY

Moriarty, P., Smits, S., Butterworth, J., & Franceys, R. (2013). Trends in rural water supply: Towards a service delivery approach. *Water Alternatives*, *6*(3), 329. https://www.water-alternatives.org/index.php/allabs/220-a6-3-1/file

Mumford, E. (2006). The story of socio-technical design: Reflections on its successes, failures and potential. *Information Systems Journal*, *16*(4), 317–342. https://doi.org/10.1111/j.1365-2575.2006.00221.x

Njoh, A. (2006). Determinants of success in community self-help projects. *International Development Planning Review*, *28*(3), 381–406.

Nyakwaka, S., & Benard, M. K. (2019a). Factors Influencing Sustainability of Community Operated Water Projects in Central Nyakach Sub-County, Kisumu County, Kenya. *International Journal of Academic Research in Business and Social Sciences*, *9*(7), Pages 108-130. https://doi.org/10.6007/IJARBSS/v9-i7/6096

Nyakwaka, S., & Benard, M. K. (2019b). Factors Influencing Sustainability of Community Operated Water Projects in Central Nyakach Sub-County, Kisumu County, Kenya. *INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS AND SOCIAL SCIENCES*, *9*(7).

Nyakwaka, S., & Benard, M. K. (2019c). Factors Influencing Sustainability of Community Operated Water Projects in Central Nyakach Sub-County, Kisumu County, Kenya. *International Journal of Academic Research in Business and Social Sciences*, *9*(7), Pages 108-130. https://doi.org/10.6007/IJARBSS/v9-i7/6096

ST. PAUL'S UNIVERSITY

Nzengya, D. M. (2018a). Improving water service to the urban poor through delegated management: Lessons from the city of Kisumu, Kenya. *Development Policy Review*, *36*(2), 190–202.

Nzengya, D. M. (2018b). Improving water service to the urban poor through delegated management: Lessons from the city of Kisumu, Kenya. *Development Policy Review*, *36*(2), 190–202. https://doi.org/10.1111/dpr.12361

Ojha, R., Thapa, B. R., Shrestha, S., Shindo, J., Ishidaira, H., & Kazama, F. (2018). Water taxation and subsidy analysis based on consumer water use behavior and water sources inside the Kathmandu Valley. *Water*, *10*(12), 1802.

Omondi, J., Odek, R., & Siringi, E. (2019). *International Journal of Economics, Commerce and Management United Kingdom Licensed under Creative Common INFLUENCE OF COMMUNITY PARTICIPATION ON PERFORMANCE OF KISUMU WATER AND SANITATION COMPANY PROJECTS IN KISUMU COUNTY, KENYA*.

Onda, K., LoBuglio, J., & Bartram, J. (2012). Global Access to Safe Water: Accounting for Water Quality and the Resulting Impact on MDG Progress. *International Journal of Environmental Research and Public Health*, *9*(3), Article 3. https://doi.org/10.3390/ijerph9030880

Onwuegbuzie, A. J., & Leech, N. L. (2005). On becoming a pragmatic researcher: The importance of combining quantitative and qualitative research methodologies. *International Journal of Social Research Methodology*, *8*(5), 375–387.

ST. PAUL'S UNIVERSITY

Oraro, E. J. (2012). *Determinants of delays in construction of community Water projects in Rachuonyo District; A case of GOK UNICEF Wash porgaramme* [PhD Thesis]. University of Nairobi, Kenya.

Organization, W. H. (2015). *Progress on Sanitation and Drinking Water: 2015 Update and MDG Assessment*. World Health Organization.

Organization, W. H. (2017a). 2017 annual report WHO/UNICEF joint monitoring programme for water supply, sanitation and hygiene. *2017 Annual Report WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene*, 20–20.

Organization, W. H. (2017b). *Progress on drinking water, sanitation and hygiene: 2017 update and SDG baselines*.

Ortigara, A. R. C., Kay, M., & Uhlenbrook, S. (2018). A review of the SDG 6 synthesis report 2018 from an education, training, and research perspective. *Water*, *10*(10), 1353.

Osborne, S., & Hammoud, M. S. (2017). Effective Employee Engagement in the Workplace. *International Journal of Applied Management and Technology*, *16*(1). https://doi.org/10.5590/IJAMT.2017.16.1.04

Ostrom, E., & Gardner, R. (1993). Coping with asymmetries in the commons: Self-governing irrigation systems can work. *Journal of Economic Perspectives*, *7*(4), 93–112.

Ovink, H., Rahimzoda, S., Cullman, J., & Imperiale, A. J. (2023). The UN 2023 Water Conference and pathways towards sustainability transformation for a water-secure world. *Nature Water*, *1*(3), 212–215.

Pearson, A. L., Zwickle, A., Namanya, J., Rzotkiewicz, A., & Mwita, E. (2016). Seasonal Shifts in Primary Water Source Type: A Comparison of Largely Pastoral Communities in

ST. PAUL'S UNIVERSITY

Uganda and Tanzania. *International Journal of Environmental Research and Public Health*, *13*(2), Article 2. https://doi.org/10.3390/ijerph13020169

Pérolat, J., Leibo, J. Z., Zambaldi, V., Beattie, C., Tuyls, K., & Graepel, T. (2017). A multi-agent reinforcement learning model of common-pool resource appropriation. *Advances in Neural Information Processing Systems*, *30*. https://proceedings.neurips.cc/paper_files/paper/2017/hash/2b0f658cbffd284984fb11d90254081f-Abstract.html

Phillips, R., & Pittman, R. (2014). *An Introduction to Community Development*. Routledge.

Price, H. D., Okotto, L. G., Okotto-Okotto, J., Pedley, S., & Wright, J. (2018). A participatory methodology for future scenario analysis of sub-national water and sanitation access: Case study of Kisumu, Kenya. *Water International*, *43*(5), 591–602.

Prüss-Ustün, A., Bartram, J., Clasen, T., Colford, J. M., Cumming, O., Curtis, V., Bonjour, S., Dangour, A. D., France, J. D., Fewtrell, L., Freeman, M. C., Gordon, B., Hunter, P. R., Johnston, R. B., Mathers, C., Mäusezahl, D., Medlicott, K., Neira, M., Stocks, M., … Cairncross, S. (2014). Burden of disease from inadequate water, sanitation and hygiene in low- and middle-income settings: A retrospective analysis of data from 145 countries. *Tropical Medicine & International Health*, *19*(8), 894–905. https://doi.org/10.1111/tmi.12329

Prüss-Ustün, A., Wolf, J., Bartram, J., Clasen, T., Cumming, O., Freeman, M. C., Gordon, B., Hunter, P. R., Medlicott, K., & Johnston, R. (2019). Burden of disease from inadequate water, sanitation and hygiene for selected adverse health outcomes: An updated analysis

ST. PAUL'S UNIVERSITY

with a focus on low- and middle-income countries. *International Journal of Hygiene and Environmental Health*, *222*(5), 765–777. https://doi.org/10.1016/j.ijheh.2019.05.004

Rahi, S. (2017). Research design and methods: A systematic review of research paradigms, sampling issues and instruments development. *International Journal of Economics & Management Sciences*, *6*(2), 1–5.

Rogers, P., & Hall, A. W. (2003). *Effective water governance* (Vol. 7). Global water partnership Stockholm.

Rondinelli, D. A. (1991). Decentralizing water supply services in developing countries: Factors affecting the success of community management. *Public Administration and Development*, *11*(5), 415–430. https://doi.org/10.1002/pad.4230110502

Ropohl, G. (1999). Philosophy of socio-technical systems. *Society for Philosophy and Technology Quarterly Electronic Journal*, *4*(3), 186–194.

Rusca, M., & Schwartz, K. (2014). 'Going with the grain': Accommodating local institutions in water governance. *Current Opinion in Environmental Sustainability*, *11*, 34–38. https://doi.org/10.1016/j.cosust.2014.09.010

Schoonenboom, J., & Johnson, R. B. (2017). How to construct a mixed methods research design. *Kolner Zeitschrift Fur Soziologie Und Sozialpsychologie*, *69*(Suppl 2), 107. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5602001/

Schweitzer, R. W., & Mihelcic, J. R. (2012). Assessing sustainability of community management of rural water systems in the developing world. *Journal of Water, Sanitation and Hygiene for Development*, *2*(1), 20–30.

ST. PAUL'S UNIVERSITY

Sima, L. C., Kelner-Levine, E., Eckelman, M. J., McCarty, K. M., & Elimelech, M. (2013). Water flows, energy demand, and market analysis of the informal water sector in Kisumu, Kenya. *Ecological Economics*, *87*, 137–144. https://doi.org/10.1016/j.ecolecon.2012.12.011

Taylor, B. (2009). Situation analysis of women, children and the water, sanitation and hygiene sector in Tanzania. *Extended Analysis of Women, Children and the Water, Sanitation and Hygiene Sector in Tanzania*.

Thomson, P., Bradley, D., Katilu, A., Katuva, J., Lanzoni, M., Kochler, J., & Hope, R. (2019). Rainfall and groundwater use in rural Kenya. *Science of The Total Environment*, *649*, 722–730. https://doi.org/10.1016/j.scitotenv.2018.08.330

Torretta, V. (2013). Environmental and economic aspects of water kiosks: Case study of a medium-sized Italian town. *Waste Management*, *33*(5), 1057–1063. https://doi.org/10.1016/j.wasman.2013.01.014

Tropp, H. (2007). Water governance: Trends and needs for new capacity development. *Water Policy*, *9*(S2), 19–30.

van Koppen, B., & Schreiner, B. (2014). Moving beyond integrated water resource management: Developmental water management in South Africa. *International Journal of Water Resources Development*, *30*(3), 543–558. https://doi.org/10.1080/07900627.2014.912111

Wagah, G. G., Onyango, G. M., & Kibwage, J. K. (2010). *Accessibility of water services in Kisumu municipality, Kenya*.

ST. PAUL'S UNIVERSITY

Whaley, L., & Cleaver, F. (2017). Can 'functionality' save the community management model of rural water supply? *Water Resources and Rural Development*, *9*, 56–66. https://doi.org/10.1016/j.wrr.2017.04.001

Winter, J. C., Darmstadt, G. L., & Davis, J. (2021). The role of piped water supplies in advancing health, economic development, and gender equality in rural communities. *Social Science & Medicine*, *270*, 113599. https://doi.org/10.1016/j.socscimed.2020.113599

Wyche, S., & Olson, J. (2018). Gender, Mobile, and Mobile Internet| Kenyan Women's Rural Realities, Mobile Internet Access, and "Africa Rising." *Information Technologies & International Development*, *14*(0), Article 0. https://itidjournal.org/index.php/itid/article/view/1595

Zentai, F., & Gronemeier, K. (2022). Tracking water governance impacts: An example from the Kenyan water sector. *Water International*, *47*(2), 321–333. https://doi.org/10.1080/02508060.2022.2042112

ST. PAUL'S UNIVERSITY

APPENDICES

APPENDICES 1: TOOLS USED FOR DATA COLLECTION

Appendix 1.1a: Operators' Focus Group Discussion Consent Form

Dear Participant,

Re: Request to participate in the Focus Group Discussions for Research on Influence of Financial Sustainability of Community Managed Borehole Water Kiosk Services

My name is Jacktone Akelo, a PhD Candidate at St. Paul's University, Limuru - Kenya. I am conducting research to examine influence of household use characteristics, technical designs and layouts, and committee governance of Community-Managed Borehole Water Kiosk Service within Kisumu County. I am requesting you to participate for a focus group discussion. Participation in the research is voluntary. There are no direct benefits for participation in the interview. However, the data generated will be useful in ensuring the community voices are considered on decisions on the designs and governance approaches for the financial sustainability of community-managed borehole water kiosks and services. Permission to undertake this research has been granted by the National Commission for Science and Technology (NACOSTI). I have also been granted permission from the Kisumu County Commissioners and Director of Education as well as the County Department of Water. In addition, if you ever have any **questions, concerns or complaints** about this research study, its procedures, risks and benefits, you can contact—anonymously if you wish—the Research Lead (**Jacktone Akelo)**, whose contact information appears on this handout. [Tel. *+254723600095 or Email joakelo1971@gmail.com*]. You can also reach out to your respective Sub-County Water Officer (+254726365793).

ST. PAUL'S UNIVERSITY

Participant Consent:

Having understood the information above and knowledge of the purpose of the interviews, with confidentiality and anonymity guaranteed, I hereby consent to participate in the interview

Participant Signature:_____**Date:**_____

St. Paul's University Repository

Thank you very much for your participation

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

Appendix 1.1b: Operators' Focus Group Discussion Guide

Influence of Household Water Use Characteristics, Technical and Governance Factors on Financial Sustainability of Community-Managed Boreholes Water Kiosk Service within Kisumu County, Kenya

Topic and Questions Guide	Areas to Probe	Discussion Notes
What is role in relations to the water kiosk and boreholes	• Design, policies, financial management • How appointed to the position • Expected/Actual activities	
Topic 1: Kiosk Network designs and layout. • Layout/Siting of Water kiosks requirements that helps ensure households to access to safe water from the kiosks domestic needs.	• Kiosk siting and customer use • Water collection design and accountability • Representation of kiosk attendants in the discussion on new kiosk siting • Kiosk design that aid collection and accountability • Layout of Water kiosk that maximizes sale from the Water Sales	
Topic 2: Committee Governance	• How water kiosks design limits profits from Water Sales • How water kiosk siting limits households water use for ALL their domestic needs • Water collection and accountability • Accountability /transparency on kiosk maintenance expenses	
Topic 3: User Households	• Seasonal variations in water collections by households.	

ST. PAUL'S UNIVERSITY

Characteristics	• Containers types and sizes • By gender how is the committee dis-aggregated?	
Topic 4: Community water project sustainability *Financial sustainability*	• Daily collections? • Who funded the establishment of the system? • Did resident source in raising this money? • Sales and record keeping	
Concluding remarks	• Information, • Questions, • Comments • Feedback	

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

Appendix 1.2a: Household Survey Questionnaire Consent Form

Akelo's PhD Research Field Questionnaire

Influence of Household Water Use Characteristics, Technical and Governance Factors on Financial Sustainability of Community-Managed Boreholes Water Kiosk Service within Kisumu County, Kenya

A: INTRODUCTORY INFORMANATION

A1: ORAL CONSENT SCRIPT

Hello. My name is _____ and I am supporting the PhD Research Candidate at St. Paul's University, Limuru with study on water design, governance and service sustainability. Are you a **head of household** for this family? [*Interview preferably a head of household (male or female), but if not possible proceed to the interview with another household member (at least 18 years old)*.]

We have selected several households from this community at **random**, which is why you have been chosen for an interview. We would thus like to ask you to participate in this study.

We would like to speak to the **person who usually manages water supply** for your family. We will ask that person some questions and mark the answers down on this survey. This survey will take about **30 - 45 MINUTES**.

We will be asking you **questions** about your household, your drinking water supply, other aspects of community life, and making some observations of your household.

Your answers will be kept **completely confidential**; your name or details will never be shared in any of the written materials produced from the study. We will use the information we collect from families here to **better understand and support community water kiosk sustainability** in this and other communities like yours as part of the PhD research.

There are **no risks** associated with any of these activities. Participants in the study **will not be paid**. Potential **benefits** of participation are that this study's results may help to improve water services in this and other communities like yours.

Again, we would like for you to participate in this survey, but participation in the study is **completely**

ST. PAUL'S UNIVERSITY

voluntary. Even if you begin to participate in the interview now, you are **free to stop participating at any time**, for any reason. We may come back to clarify again, if necessary, and **you are free to accept or decline at any time.**

We have spoken with your **water kiosks and government leaders**, and they are available to speak with you about this study at any time. In addition, if you ever have any **questions, concerns or complaints** about this research study, its procedures, risks and benefits, you can contact—anonymously if you wish —the Research Lead **(Jacktone Akelo)**, whose contact information appears on this handout. [*Tel +254723600095 or Email joakelo1971@gmail.com*]. You can also reach out to your respective Sub-County Water Officer (+254726365793).

A1a: Do you have any **questions** about the purpose of, or the activities involved in, this study? [*Make note of, and answer, any questions asked*.]

A1b: Can you tell me if you would be **willing to participate** in our study?

____ Yes [Participant Signs_____ Date:_____

____ No [THANK respondent and proceed to next household]

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

Appendix 1.2b: Household Survey Questionnaire

Akelo's PhD Research Field Questionnaire

Influence of Household Water Use Characteristics, Technical and Governance Factors on Financial Sustainability of Community-Managed Boreholes Water Kiosk Service within Kisumu County, Kenya

Administer informed consent. If subject agrees to participate, proceed to questionnaire	
A2c: Please select the sub-county	⇨ Nyakach ⇨ Nyando ⇨ Seme
A2d: Write the Ward Name	
A2e: Write the Borehole name from where the Kiosk is extended	⇨ Bolo ⇨ Oremo ⇨ Ragen ⇨ Boya ⇨ Olasi ⇨ Withur ⇨ Aluala ⇨ Korwenjo ⇨ Kuoyo Kaila
A2f: Write the name of nearby water kiosk	
A3c(ii): What is the gender of head of household?	⇨ Female ⇨ Male
A3c(iii) What is the estimated age of the head of the household?	_____years
A3c(iv): What is the main occupation of the head of household? (select only one)	⇨ Farming ⇨ Business ⇨ Fisher folk ⇨ Employed ⇨ Daily labour ⇨ Self employed

ST. PAUL'S UNIVERSITY

	⇨ House wife/father ⇨ None/Not applicable		
A3c(v): What is the highest education level has head of household completed?	⇨ No schooling ⇨ Primary ⇨ Secondary ⇨ College (Artisan, Certificate or Diploma) ⇨ University (Bachelors, Masters or PhD)		
A3e: How many people in TOTAL, including you, currently live in the household?	_____people		
A3f: How many children are 0 to 18 years in this household?	_____people		
A3h: How many children go to school?	_____children		
A4: Main and Secondary Source of Drinking Water A4a(i): What is your main drinking water?	⇨ Tap (public/private plot) ⇨ Borehole kiosk (public) ⇨ Hand pump (public/private) ⇨ Spring (protected/unprotected) ⇨ Dam/Pan/River/Lake ⇨ Vendor/Bottled water ⇨ Harvested Rain Water ⇨ Others (specify)		
Regularity of Use	**Always**	**Half the times**	**Never**
A4a(ii)1: How often did you collect your water from the Borehole kiosk as the main source?			
A4c(i): If kiosk is not used either as primary or secondary source	⇨ If kiosk is either main water		

ST. PAUL'S UNIVERSITY

of drinking ,household is thanked for their time and survey ends	source or secondary source, continue to answer other questions ⇨ If not main or secondary source, stop

B: Kiosk Network Designs and Layout

B1a(i): How much pressure does the water Borehole kiosk usually come when open?	⇨ Low pressure ⇨ Medium/fair pressure ⇨ High pressure ⇨ Very high pressure		
Ranking Satisfaction, Commitment and Unaccounted for Water	1	3	5
B3a(ix): Rank how committed you are to always collect your water from the water kiosk all year long? (With 1=Not at all committed; 3= Rather committed and 5 = Very committed)			

C. Committee Decision-Making Processes

C1: Borehole and Kiosk Membership			
C1a(i): Household Becoming Members of the Borehole water kiosk	***Yes***	**No**	**Don't Know**
C1a(i)1: Payment of membership			
C1a(i)2: Living within the area to benefit			
C1a(iii)1: If you paid for membership, how much did you pay?	KES ……		
Water Borehole and Kiosk Committee Functions	**Yes**	**No**	**Don't**

ST. PAUL'S UNIVERSITY

			Know
Is there a water committee that is responsible for management of the Borehole?			
C2a(i)1: There is a water committee that is responsible for management of the Borehole water kiosk?			
C2a(i)2: There is a water committee that is responsible for management of the Borehole water kiosk?			
Household Involvement in Water Committee or Management	**Yes**	**No**	**Don't Know**
C2a(iii)1: Someone from this household is involved in the management of the water supply system in this community			
C2a(iii)2: Someone from this household is a member of the water management committee?			
C3a(i): How often does Water management committee meet with water users to discuss issues about the water system?	⇨ Monthly ⇨ Bimonthly ⇨ Once every 3 months ⇨ Once every 6 months ⇨ Once per year ⇨ As needed ⇨ Never ⇨ Don't know/No answer ⇨ Others		
C3a(ii): **Did you** or a member of your household attend the last. Water users' meeting with the committee	⇨ yes, attended ⇨ no, was not invited ⇨ no, was invited by did not attend ⇨ no, a meeting was not held ⇨ Cannot remember		

ST. PAUL'S UNIVERSITY

C6a(i): Who owns the land where the Borehole is established?	⇨ County government land ⇨ National government land ⇨ Individual land ⇨ Community public land ⇨ Others (specify) ⇨ Don't know
C7a(i): Who owns the land where the kiosk is established?	⇨ County government land ⇨ National government land ⇨ Individual land ⇨ Community public land
C9a(i): Do you have a schedule of opening and closing for your nearest Borehole water kiosk?	⇨ No ⇨ Yes ⇨ Don't know
C9a(ii)1:What time does the water kiosk operate during the day?	⇨ All day long ⇨ In the morning (6-10 AM) ⇨ In the afternoon (4-7 /PM) ⇨ Others (specify) ⇨ Don't know
C9a(iii)2: Do you have an operator/attendant for the water kiosk?	⇨ No ⇨ Yes ⇨ Don't know

ST. PAUL'S UNIVERSITY

D. Beneficiary Characteristics

Beneficiary Household Incomes	
D2a(ii): How frequent is the earning of your household	⇨ Daily ⇨ Weekly ⇨ Biweekly

	⇨ Monthly ⇨ Semi-annually ⇨ Annually
D3a(v): How satisfied are you with your kiosk as drinking water source kiosk?	⇨ Satisfied ⇨ Dissatisfied ⇨ Extremely dissatisfied
D4a(i): Is your kiosk drinking water source available when needed?	⇨ No ⇨ Yes
D4a(ii): How many hours per day does water from the kiosk available? (kiosk operating time in a day)	----------Hours
D4a(iii): How long does a trip (back and forth) to your water kiosk take, including time required to queue and to fill the containers?	----------Minutes
D4a(iv): Is your drinking water kiosk functioning now?	⇨ Yes, functioning well ⇨ Yes, functioning but not well ⇨ No, not functioning
D5a: Water Use Seasonality - Dry Seasons	
D5a(i)3: How often do you go to this water source during dry season to collect the water for drinking purpose?	⇨ Once per day ⇨ Twice per day ⇨ Thrice per day ⇨ More than four time ⇨ Not applicable
D5a(ii)3: How often do you go to this water source during dry season to collect the water for washing and cleaning purpose?	⇨ Once per day ⇨ Twice per day ⇨ Thrice per day ⇨ More than four time ⇨ Not applicable
D5a(iii)3: How often do you go to this water source during dry season to collect the water for bathing purpose?	⇨ Once per day ⇨ Twice per day

ST. PAUL'S UNIVERSITY

	⇨ Thrice per day ⇨ More than four time ⇨ Not applicable
D5b: Water Use Seasonality - Rainy Seasons	
D5b(i)3: How often do you go to this water source during rainy season to collect the water for drinking purpose?	⇨ Once per day ⇨ Twice per day ⇨ Thrice per day ⇨ More than four times ⇨ Not applicable
D5b(ii)3: How often do you go to this water source during rainy season to collect the water for washing and cleaning purpose?	⇨ Once per day ⇨ Twice per day ⇨ Thrice per day ⇨ More than four times ⇨ Not applicable
D5b(iii)3: How often do you go to this water source during rainy season to collect the water for bathing purpose?	⇨ Once per day ⇨ Twice per day ⇨ Thrice per day ⇨ More than four times ⇨ Not applicable
D6a(i): YESTERDAY, can you tell me how many times you collected water from the kiosk?	----------times
D6a(ii): Is the number of times the same in all seasons (rainy and dry)?	⇨ Yes ⇨ No ⇨ Don't know
D6a(iii): In what season do you go several times to collect water from the kiosk	⇨ Same across seasons ⇨ Rainy seasons ⇨ Dry seasons
D7a(i): Who collects water from the source for the household use	⇨ Female adult ⇨ Male adult ⇨ Other female member

ST. PAUL'S UNIVERSITY

	⇨ Other male vendor ⇨ Buy from the water hawking vendor		
D8a(i): What kind of containers do you use to collect and transport water from the source?	⇨ Plastic jerricans (20-litres) ⇨ Plastic jerricans (10-litres) ⇨ Plastic jerricans (05-litres) ⇨ Plastic bucket with large opening ⇨ Clay pot ⇨ Others (specify)		
D8a(ii): Do you use the same container for water transport and water storage?	⇨ Yes ⇨ No		
D9a(i): What kind of containers do you use to store the drinking water?	⇨ Clay pot ⇨ Small container with a tap ⇨ Small container without a tap ⇨ Large container with a tap ⇨ Large container without a tap		
D10a(i): How many trips did you make to the water source yesterday?	---------trips		
D10a(ii): Was the water you collected yesterday sufficient for your household need?	⇨ Yes ⇨ No ⇨ Kind off		
D11a(i): Do you know the members of the committee managing the water point?	⇨ Yes ⇨ No		
D11: Beneficiary Level of Satisfaction with Siting	**Satisfied**	**Dissatisfied**	**Extremely dissatisfied**
D11d(ii):How satisfied are you about where the kiosk is sited?			
D12: Beneficiary Level of Commitment Now I'd like to ask you about your feelings of ownership and	**Very true**	**Rather True**	**Not true at all**

ST. PAUL'S UNIVERSITY

commitment to the kiosk. Please think of items that you own, such as a bike or the furniture in your home. Now please think of the borehole kiosk and tell me your commitment to:			
D12a(ii):This is OUR COMMUNITY'S drinking water system.			
D12a(iii): My family is one of the owners of the water system			
D12a(iv): The water system is owned by all the people who live in this village.			

F. Community Water Kiosk Sustainability

Contributions Towards Water Source Establishment	**Yes**	**No**	**Don't Know**
F1b(i): Did your household contribute towards the establishment of the water kiosk?			
F2b(i): Do you pay to collect your water from the kiosk?			
Appropriate Payment Method			
F2a(ii): In your opinion rank the following statement in terms of 1 - 5 (with 1 = dissatisfied; 3 = rather satisfied and 5 = most satisfied	**1 (Dissatisfied)**	**3 (Rather Satisfied)**	**5 (Most Satisfied)**
F2a(ii)1: The most appropriate way for payment at water kiosk should on a monthly basis			
F2a(ii)2: The most appropriate way for payment at water kiosk should be on pay-as-you collect			
F2a(ii)3: The most appropriate way for payment at water kiosk should on billing only those who have water in their compound			
F2a(ii)4: The way the information from the meter used is good			

ST. PAUL'S UNIVERSITY

F5g: Daily Operations and Maintenance of Water Kiosks	Yes	No	Don't Know
F5g(i): Is there a technician/plumber to look after your main drinking water kiosk?			
F5g(ii): Do you know whether the technician/plumber is paid on work done by the committee?			
F5g(iii): Is there a water kiosk operator or salesperson			

Thank You Very Much for Your Responses

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

Appendix 1.3a: Key Informant Interview Consent Form

Influence of User Household Characteristics, Technical and Governance Factors on Financial Sustainability of Community-Managed Boreholes Water Kiosk Service within Kisumu County, Kenya

Dear Participant,

Re: Request to participate in the Key Informant Interview for Research on Influence of Financial Sustainability of Community Managed Borehole Water Kiosk Services

My name is Jacktone Akelo, a PhD Candidate at St. Paul's University, Limuru - Kenya. I am conducting research to examine influence of household use characteristics, technical designs and layouts, and committee governance of Community-Managed Borehole Water Kiosk Service within Kisumu County. I am requesting you to participate for key informant in-depth interviews. Participation in the research is voluntary. There are no direct benefits for participation in the interview. However, the data generated will be useful in ensuring the community voices are considered on decisions on the designs and governance approaches for the financial sustainability of community-managed borehole water kiosks and services. Permission to undertake this research has been granted by the National Commission for Science and Technology (NACOSTI). I have also been granted permission from the Kisumu County Commissioners and Director of Education as well as the County Department of Water. In addition, if you ever have any questions, concerns or complaints about this research study, its procedures, risks and benefits, you can contact—anonymously if you wish—the Research Lead (Jacktone Akelo), whose contact information appears on this handout. [Tel +254723600095 or Email joakelo1971@gmail.com]. You can also reach out to your respective Sub-County Water Officer (+254726365793).

Participant Consent:

Having understood the information above and knowledge of the purpose of the interviews, with confidentiality and anonymity guaranteed, I hereby consent to participate in the interview

Participant Signature: _____ **Date:**_____

Thank you very much for your participation

ST. PAUL'S UNIVERSITY

St. Paul's University Repository

Appendix 1.3b: Key Informant Interview Check-list

Influence of User Household Characteristics, Technical and Governance Factors on Financial Sustainability of Community-Managed Boreholes Water Kiosk Service within Kisumu County, Kenya

(County Water Officers)

a. implementation policy and legal frameworks for the water boreholes water services within their respective jurisdictions,
b. appropriate technology,
c. design and layout of the borehole and design for kiosks,
d. the maintenance of quality,
e. enforcement of management and functionality of water service systems.

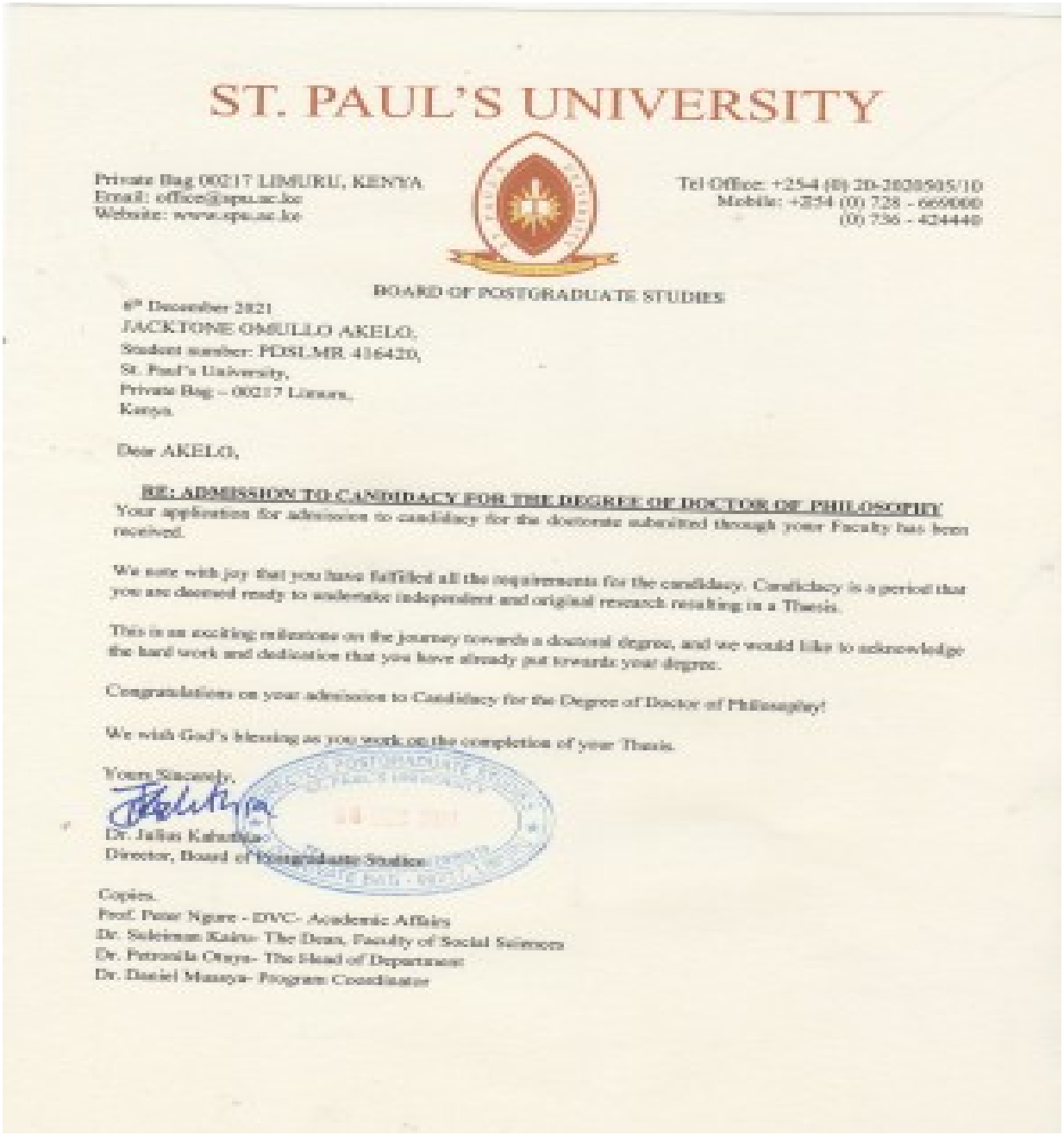
(Committee Secretaries/Treasurers)

a) frequency of meetings;
b) training of operators;
c) corporation with other agencies;
d) budgeting, record and book-keeping, savings and spending policies
e) costs of construction and future plans for the borehole expansion or otherwise.

ST. PAUL'S UNIVERSITY

APPENDICES 2: ETHICAL AND APPROVAL DCUMENTS

Appendix 2.1: Letter of Admission to PhD Candidacy



ST. PAUL'S UNIVERSITY

Private Bag 00217 LIMURU, KENYA
Email: office@spu.ac.ke
Website: www.spu.ac.ke

Tel Office: +254 (0) 20-2020505/10
Mobile: +254 (0) 728 - 669000
(0) 736 - 424440

BOARD OF POSTGRADUATE STUDIES

6th December 2021
JACKTONE OMULLO AKELO,
Student number: PDSLMR 416420,
St. Paul's University,
Private Bag – 00217 Limuru,
Kenya.

Dear AKELO,

RE: ADMISSION TO CANDIDACY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Your application for admission to candidacy for the doctorate submitted through your Faculty has been received.

We note with joy that you have fulfilled all the requirements for the candidacy. Candidacy is a period that you are deemed ready to undertake independent and original research resulting in a Thesis.

This is an exciting milestone on the journey towards a doctoral degree, and we would like to acknowledge the hard work and dedication that you have already put towards your degree.

Congratulations on your admission to Candidacy for the Degree of Doctor of Philosophy!

We wish God's blessing as you work on the completion of your Thesis.

Yours Sincerely,

Dr. Julius Kahumbu
Director, Board of Postgraduate Studies

Copies.
Prof. Peter Ngure - DVC- Academic Affairs
Dr. Suleiman Kainu- The Dean, Faculty of Social Sciences
Dr. Perronila Otuya- The Head of Department
Dr. Daniel Masaya- Program Coordinator

Appendix 2.2: Letter of Introduction to NACOSTI

ST. PAUL'S UNIVERSITY

Private Bag 00217 LIMURU, KENYA
Email: office@spu.ac.ke
Website: www.spu.ac.ke

Tel Office: +254 (0) 20-2020505/10
Mobile: +254 (0) 728 - 669000
(0) 736 - 424440

BOARD OF POSTGRADUATE STUDIES

6th December 2021

National Commission for Science and Technology,
P.O. BOX 30623-00100,
Nairobi.

Dear Sir/Madam,

RE: RECOMMENDATION FOR JACKTONE OMULLO AKELO - PDSLMR 416420 TO CONDUCT RESEARCH

This letter confirms the above named person is a PhD student in Development Studies at St. Paul's University.

The second year consists of a major research work leading to a thesis. The student's selected topic is *"MODELING TECHNICAL AND GOVERNANCE FACTORS INFLUENCING SUSTAINABILITY OF COMMUNITY-MANAGED BOREHOLE WATER KIOSK SERVICE IN KISUMU COUNTY, KENYA."*
Kindly grant this student the required permit.

Yours Faithfully,

Dr. Julius Kahuthia
Director, Board of Postgraduate Studies

Appendix 2.3: NACOSTI Research Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 216342

Date of Issue: 12/December/2021

RESEARCH LICENSE



This is to Certify that Mr.. Jackions Omullo Akelo of St. Paul's University, has been licensed to conduct research in Kisumu on the topic: MODELING TECHNICAL AND GOVERNANCE FACTORS INFLUENCING SUSTAINABILITY OF COMMUNITY-MANAGED BOREHOLE WATER KIOSK SERVICE IN KISUMU COUNTY, KENYA for the period ending : 12/December/2022.

License No: NACOSTI/P/21/14844

216342

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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

St. Paul's University Repository

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

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

CONDITIONS

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

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

ST. PAU

St. Paul's University Repository

Appendix 2.4: Letter from Water Department, County Government of Kisumu

ST. PAUL'S UNIVERSITY

REPUBLIC OF KENYA

THE COUNTY GOVERNMENT OF KISUMU

Office of County Executive Committee Member for Water, Climate Change, Environment & Natural Resources

CGK/CECM/WCCE&NR/008/VOL.1 (251) *14th February, 2022*

Mr. Jactone Okello

RE: RESEARCH ON COMMUNITY WATER SUSTAINABILITY

Reference is made to your e-mail communications on the above subject.

We acknowledge and appreciate your decision to undertake research in Kisumu County. We anticipate to get findings of the research which will indeed add value to our processes in ensuring sustainable management of community water supplies.

As indicated in your email, you have planned to undertake your research in three Sub-counties (Seme, Nyakach and Nyando). You are therefore required to engage the following Officers to support in your research;-

1. Madam Beatrice Otieno - Sub-County Water Officer (Seme)
2. Mr Peter Ngetich - Sub-County Water Officer (Nyakach)
3. Madam Emma Oginga - Sub-County Water Officer (Nyando

Salmon Orimba

CECM – WATER, CLIMATE CHANGE, ENVIRONMENT & NATURAL RESOURCES

Cc; - Chief Officer - Water and Sewerage Services
Sub-County Water Officers - Seme
Sub-County Water Officers - Nyakach
Sub-County Water Officer - Nyando

Prosperity House (Former Nyanza Provincial Headquarters Building) 11th Floor
P. O. Box 2738 – 40100 Kisumu City
Email. s.orimba@kisumu.go.ke/s.orimba@yahoo.com

Appendix 2.5: Ethical Board Approval by DURB

VERDICT – APPROVAL WITH COMMENTS
Daystar University Ethics Review Board

Our Ref: **DU-ERB/31/01/2022/000625**

Date: 31st January 2022

To: Jacktone Omullo Akelo

Dear Jacktone,

RE: MODELING TECHNICAL AND GOVERNANCE FACTORS INFLUENCING SUSTAINABILITY OF COMMUNITY-MANAGED BOREHOLE WATER KIOSK SERVICE IN KISUMU COUNTY, KENYA

DAYSTAR UNIVERSITY
Excellence · Transformation · Servant-Leadership
Valley Road Campus
P.O. Box 44400 - 00100,
Nairobi, Kenya
Athi River Campus
P.O. Box 17, Daystar University,
90145, Athi River, Kenya
Tel: 0716 170 313/ 0748 100 759/
0724256408-9 OR
0709 972 000 (30 lines)
E-mail: admissions@daystar.ac.ke
info@daystar.ac.ke
Facebook: daystar-university-official
Twitter: daystaruni
www.daystar.ac.ke

Reference is made to your ERB application reference no. 170122-01 dated 17th January 2022 in which you requested for ethical approval of your proposal by Daystar University Ethics Review Board.

We are pleased to inform you that ethical review has been done and the **verdict is to revise to the satisfaction of your Supervisors before proceeding to the next stage.** As guidance, ensure that the attached comments are addressed. Please be advised that it is an offence to proceed to collect data without addressing the concerns of Ethics Review board. Your application approval number is **DU-ERB-000625.** The approval period for the research is between ***31st January 2022 to 30th January 2023*** after which the ethical approval lapses. Should you wish to continue with the research after the lapse you will be required to apply for an extension from DU-ERB at half the review charges.

This approval is subject to compliance with the following requirements.

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

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

Yours sincerely,

31st Jan 2022

Sr. Prof. A. L. Lando PhD
Chair, Daystar University Ethics Review Board

DAYSTAR UNIVERSITY ETHICS REVIEW BOARD
31 JAN 2022
P.O. Box 44400 - 00100, NAIROBI

Encl. Review Report

"...until the day dawn and the ***daystar*** *arise in your hearts"*
2 Peter 1:19 KJV

St. Paul's University Repository

ST. PAUL'S UNIVERSITY