

Informal Small-Scale Water Supply System: Influence on Water Service Delivery in Informal Settlements: A Case Study of Mukuru Kwa Njenga, Nairobi City County.

By

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DEDICATION.

To Isabella Odipo, Phillemon Agira, Mr. & Mrs. Odhiambo, Verona, Fiona, Noel, and all my respondents in Mukuru Kwa Njenga.

Shukran!!!

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TABLE OF CONTENT.

DECLARATION OF ORIGINALITY FORM.....	ii
DECLARATION.....	iii
DEDICATION.....	iv
ACKNOWLEDGEMENT.....	v
TABLE OF CONTENT.....	vi
LIST OF TABLES.....	ix
LIST OF FIGURES.....	x
ACRONYMS.....	xi
ABSTRACT.....	xii
CHAPTER 1: INTRODUCTION.....	1
1.1 Problem statement.....	3
1.2 Research Questions.....	4
1.3 Research objectives.....	5
1.4 Justification for the Study.....	5
1.5 Scope and Limitation of the Study.....	6
1.6 Definition of Key Concepts.....	7
CHAPTER 2: LITERATURE REVIEW.....	8
2.1 Theoretical Framework.....	8
2.2 Empirical Literature.....	10
2.2.1 The Sources of Water Supply in Urban Informal Settlements.....	10
2.2.2 Informal Water Supply Challenges.....	14
2.2.3 Household Perspectives on Water Access.....	15
2.2.4 International Standards on Access to Water.....	17
2.2.5 Legal Framework on Water Service Provision in Kenya.....	17
2.2.5.1 Existing Legal Framework.....	17
2.3 Conceptual Framework.....	19

CHAPTER 3: RESEARCH METHODOLOGY.....	20
3.1 Introduction.....	20
3.2 Research Design.....	20
3.3 Study Site.....	21
3.4 Target Population & Study Population.....	22
3.5 Sampling.....	22
3.6 Planning for Key Informants.....	23
3.7 Data Collection.....	23
3.8 Data Analysis.....	24
CHAPTER 4: RESEARCH FINDINGS AND DISCUSSION.	
4.1 Introduction.....	25
4.2 Descriptive Analysis.....	25
4.3 Characteristics of The Sample.....	25
4.3.1 Respondents Gender.....	25
4.3.2 Respondents Age.....	27
4.3.3 Household Size.....	27
4.3.4 Employment Type and Monthly Income.....	28
4.3.5 Water Source.....	30
4.3.6 Structure Tenure.....	31
4.3.7 Neighborhood and Location.....	32
4.3.8 Water Service Delivery.....	32
4.3.9 Descriptive Summary.....	34
4.4 Bivariate Analysis.....	35
4.5 Challenges of The Informal Small-Scale Supply System.....	35
4.6 Household Perception of The Informal Small-Scale Supply System.....	36
4.6.1 Summary.....	38
CHAPTER 5: SUMMARY, CONCLUSION AND RECOMMENDATION.....	40
5.1 Summary.....	40
5.2 Conclusion.....	42
5.3 Recommendation.....	43
REFERENCES.....	44

APPENDICES	49
Appendix 1: Survey Questionnaire with Informal Small-Scale Water Operators	50
Appendix 2: Household Survey Questionnaire	55
Appendix 3: Key Informant Guide	62

LIST OF TABLES

Table 1: The Informal small-scale operators' gender.....	25
Table 2: Gender Cross tabulation across the three study settlements.....	26
Table 3: The Informal small-scale suppliers household size.....	27
Table 4: Household Composition for household respondents.....	28
Table 5: Employment Type.....	28
Table 6: Average Income.....	29
Table 7: Structure Tenure.....	31
Table 8: Structure tenure by stay duration.....	31
Table 9: Effects of flooding in the settlement.....	32
Table 10: Frequency of water access.....	32
Table 11: HH daily water consumption.....	33
Table 12: Chi-square test between the dependent variables and predictors.....	35

LIST OF FIGURES

Figure 1: Conceptual framework.....	19
Figure 2: Waterpoint and sanitary location in Mukuru Kwa Njenga.....	21
Figure 3: Age grouping.....	27
Figure 4: Average income across the three settlements.....	30

ACRONYMS.

DAWASCO	Dar es Salaam Water and Sewerage Corporation.
IDS	Institute for Development Studies.
ISD	Informal Settlements Department.
Ksh	Kenya Shillings.
NCWSC	Nairobi City Water and Sewerage Company.
SDG	Sustainable Development Goals.
SPSS	Statistical Package for Social Science.
SSA	Sub-Saharan Africa.
WASREB	Water Service Regulation Board.
WARMA	Water Resource Management Authority.
WSP	Water Service Providers.
WHO	World Health Organization.
WRUA	Water Resource User Association.
WSTF	Water Service Trust Fund.

ABSTRACT.

The research paper sought to examine the influence of the informal small-scale supply system on domestic water service delivery in Mukuru Kwa Njenga, Nairobi City County, by establishing the vendors' primary water source, analyzing the challenges, and assessing household perceptions of the system. The study was anchored on the living condition diamond framework to assess the living conditions of the informal small-scale operators and the influence on domestic water service delivery in the studied settlements. A mixed-method approach was employed in the study. The quantitative strand involved the administration of questionnaires on randomly sampled households and informal small-scale operators. On the other hand, the qualitative strand employed the use of key informants guides to purposively selected informants. 105 households, 67 informal small-scale operators, and 4 key informants were interviewed for the study. Data analysis involved; descriptive, bivariate, and thematic analysis for the qualitative data. The study findings reveal that the informal small-scale operators appropriated water from the state's utility channeled through the chambers. The owners operated the water enterprise and made an average of Ksh. 400 daily. The main challenges experienced by the operators were electricity and debts from clients. In terms of perception, households were positive about the vendors' initiative in the settlement. However, the study findings did not find a significant association between the variables in the study sample. The cross-tabulations yielded p values >0.05 . Generally, the study findings reveal the significant contribution of the informal small-scale operators in urban informal settlements in the absence of the state's utility

CHAPTER 1: INTRODUCTION

Access to adequate water is fundamental to our everyday life. Unprecedented urbanization and population growth, particularly in Sub-Saharan Africa, have led to soaring demands at the expense of inadequate investments to expand service provision (Chitonge, 2014). Through migrations and natural increase, the global population is projected to rise to about 2.5 billion (Dos Santos et al., 2017). Also, the population in SSA, is expected increase to about 1.1 billion people (Dos Santos et al., 2017). Most people (about 844 million) do not have access to an improve water source (Dos Santos et al., 2017). Access disparities are considerably high in urban areas, with informal settlements bearing the burden of water access. Contrary to the assumption provided by (Dos Santos et al., 2017), in Sub-Saharan Africa, urban expansion is occurring in informal settlement areas with inadequate service provision.

Similarly, Kenya has experienced significant population growth. According to national statistics, there has been an increase in population from 10.9M in 1969 to about 47.6M in 2019 (KNBS, 2019). In 2018, 27% of the country's population lived in towns and cities (UN-Habitat, 2019). Urbanization trends in the country are expected to remain high. By 2050, at least 50% of Kenya's population will be urban residents (UN-Habitat, 2019; World Bank, 2016). Informal settlements are estimated to constitute approximately 60% of the city's population, occupying just 5% of the city's 684 square Kilometers (Kamau & Njiru, 2018; Sarkar, 2019).

Informal settlements are urban residential areas that develop outside the legal system, intended to record tenure and enforce compliance with prescribed rules (Satterthwaite et al., 2020). Each settlement has a distinct feature: history, structure, and magnitude of challenges (Crow & Odaba, 2010). Nonetheless, they are characterized by climate vulnerabilities, unemployment, tenure insecurity, poverty, overcrowding, and a lack of service provision such as water, roads, and electricity (Corburn & Sverdlik, 2019; Simiyu et al., 2019).

Access in urban informal settlements is often typified by low coverage with poorly functioning systems, often resulting in high quantities of unaccounted-for water (Boakye-Ansah et al., 2019a).

(WASREB, 2018) estimates a 20% coverage in informal settlements against 57% national coverage (WASREB, 2021). Without utility mains, most individuals source domestic water from uncovered wells, rivers, and small-scale supply systems. Multiple factors hinder water access in informal settlements: colonial land segregation, which has continued to shape water access; poverty, lack of government support toward informal settlement development, and low political priority, among others (Chitonge, 2014; Kamau & Njiru, 2018; Kjellén & McGranahan, 2006; Sarkar, 2019). From the service provider's perspective, the task of water provision is quite a challenge given the socioeconomic and legal characteristics, low consumption rates, and the nature of spontaneity (Boakye-Ansah et al., 2019b). As a result, women and children bear the inconvenience of poor water access. A study examining water vendors' operations in Mathare found that women spent most of their time queuing for an average of 10-15 minutes, and in times of scarcity, they had to fetch water at the expense of missing their daily employment (Sarkar, 2020b).

In line with other SSA countries, Kenya adopted privatization in the 1980s and 1990s to remedy urban water supply (K'akumu & Appida, 2006). This was instituted with the notion that competition between water service providers could significantly contribute to revenue generation and expand service provision through private investments (Adams et al., 2019). However, due to vested interests and a lack of operational frameworks heightened corruption and laxity within the water sector, privatization failed to improve water access (K'akumu & Appida, 2006). Also, the private sector contract did not provide obligations for water supply in areas lacking security of tenure (Dagdeviren & Robertson, 2011).

As a result, informal entrepreneurs have emerged to fill the supply-demand gap for the increasing population, particularly in the informal settlement areas (Dakyaga et al., 2018). About 80% of the SSA urban population depends entirely on informal small-scale water suppliers (Dakyaga et al., 2018). A study examining access challenges emanating from the use of standpipes in the Mathare settlement (Sarkar, 2019) found that domestic reselling was more prevalent in areas with stressed or sparingly located standpipes - about 75% purchased water from the distributing and fixed vendors. The small-scale informal supply systems consist of unregulated or regulated service providers sourcing water from the utility main or other service providers to service those unserved by the state (Braumah et al., 2018).

Scholars (Ahmad, 2017; Wutich et al., 2016) describe the informal small-scale water supply markets as “an old urban phenomenon” that has received great scholarly attention. However, the spatiality and complexity surrounding informal water supply market operation in Sub-Saharan Africa render the discussions unexhaustive (Dakyaga et al., 2018). Recently, more discussions have emerged, interrogating the emergence, the market operations of informal water providers, persistence, their contribution to enhancing water access in informal settlements, and the challenges. For instance, (Mapunda et al., 2018a) examined the operations of the informal water markets, significant contributions, challenges, and prospects in dispersed urban settlements, Dar-es-Salaam. (Braumah et al., 2018) examined community perceptions about the water vendors and the challenges to enhancing pro-poor water policy mainstreaming in Ghana. (Sarkar, 2020b) adopted the human right to water approach (Wutich et al., 2016) to examine distributive, interactional, and procedural injustices in the Mathare settlement.

Given the heterogeneity of informal market operations and perception of the sector, this paper seeks to contribute empirical literature on market operations, challenges, and households' perceptions of informal small-scale water service provision in the Mukuru Kwa Njenga settlement. The results of the study are to inform policymakers about the potential acceptability of alternative service provision strategies in urban informal settlements.

1.1 Problem statement.

In studying water access in informal settlements, scholars have highlighted some of the daily struggles women and girls undergo to obtain adequate water for domestic consumption in SSA (Crow & Odaba, 2010; Sarkar, 2020a; Tutu & Stoler, 2016). Poor service provision in these informal settlements is attributed to the complex characteristics of informal settlements, low political priority, governance failure, and colonialism (Chitonge, 2014; Kamau & Njiru, 2018; Sarkar, 2019). Adding to the challenge of poor water supply, Kenya is experiencing a rapid explosion in its population due to unprecedented urbanization (Kamau & Njiru, 2018). Urban areas are project to have about 50% of the entire population (UN-Habitat, 2019; World Bank, 2016). These trends support the expansion of informal settlements. One such settlement is Mukuru Kwa Njenga, within the Embakasi constituency.

Mukuru has a population of 301,683 people and is projected, at a conservative 6% annual population growth rate, to increase to about 682,075 persons by 2030 (Corburn et al., 2017). Despite being surrounded by an industrial belt of manufacturing centers, the informal settlement is spatially segregated (Corburn et al., 2017). Public water points in western Mukuru kwa Reuben are concentrated in high-density areas and situated at distances ranging from 25 to 80 meters. Other parts, such as Eastern Kwa Reuben, Central Viwandani, and Kwa Njenga, have little or no water points within a 300m range (Corburn et al., 2017). Generally, only 1% of the informal residents have access to an individual water source. Attempts to improve service delivery in Mukuru informal settlements have focused on distributional technology by introducing chamber models through the NCWSC in collaboration with government donor agencies and the World Bank-WSP (Crow & Odaba, 2010).

Amidst these efforts, access to water by Mukuru residents remains a challenge. Consequently, informal small-scale water supply markets have emerged, mostly appropriating water from the utility's main networks by reselling or illegally cutting into municipal pipes and other sources to sustain service provision in these settlements. While their activities are fast-growing, it is important to interrogate the operations, challenges, and household perceptions of the informal entrepreneurs in the Mukuru settlement. Although past studies have highlighted the significance of small-scale water providers (Brammah et al., 2018; Kjellén & McGranahan, 2006; Mapunda et al., 2018b; Sarkar, 2020b), there has been no argument presented for Mukuru Kwa Njenga informal settlement.

1.2 Study Research Questions.

Overall study research question: What is the influence of the informal small-scale water supply system on water service delivery in Mukuru Kwa Njenga?

General Questions.

1. What are the water sources in Mukuru Kwa Njenga?
2. What challenges are experienced by the informal small-scale water supply system in Mukuru Kwa Njenga?
3. How has the informal small-scale water supply system influenced water service delivery in Mukuru Kwa Njenga?

1.3 Study Research Objectives.

Overall Research Objective: To determine the influence of the informal small-scale water supply system on water service delivery in Mukuru Kwa Njenga.

Specific Research Objectives.

1. To establish water sources in Mukuru Kwa Njenga settlements.
2. To analyze the challenges experienced by the informal small-scale water supply system in Mukuru Kwa Njenga informal settlement.
3. To determine the influence of the informal water supply system on water service delivery in Mukuru Kwa Njenga.

1.4 Justification.

According to (Sarkar, 2020b), case studies on the informal water providers that emerged after the 1990s have generally focused on two groups of thought. World Bank-sponsored studies, such as (Cairncross & Mundial, 1992; Komives & Cowen, 1998; Solo, 1998), have applauded water vendors as independent service providers significantly contributing to service provision without the municipal infrastructure. Other studies (Dagdeviren & Robertson, 2011; Olajuyigbe et al., 2012) interrogate vended water prices, regulations, and quality of water provided to consumers. Conversely, (Whittington et al., 1989) examined the informal water enterprise in developing countries and found that water resale was competitive and that market mechanisms majorly determined water prices.

Recently, more discussions have emerged, interrogating the emergence, the market operations of informal water providers, persistence, their contribution to enhancing water access in urban informal areas, and the challenges (Dakyaga et al., 2018; Mapunda et al., 2018b; Wutich et al., 2016). In Kenya, (Sarkar, 2020b) examines informal water vendors in Mathare. Overall, the study aims to add to the existing literature on informal small-scale enterprise and provide evidence about the potential acceptability of alternative service provision approaches in informal settlements.

1.5 Scope and Limitation of the Study.

Data was collected in three informal settlements; Wape Wape, Vietnam, and Riara in Nairobi City County. The focus was on the Informal small-scale water supply system as the unit of analysis. Given the difficulty in obtaining data from the informal small-scale supply system (Sarkar, 2020b; Wutich et al., 2016), households were incorporated into the study.

Due to the inadequate information on the exact number of informal operators in the study settlements, the researcher adopted the transect method to identify operators in every street of the study settlements. 25 informal small-scale operators were interviewed in Vietnam and Riara, and only 17 in Wape Wape due to security reasons. In total, 67 informal small-scale supply operators were interviewed for the study. Additionally, interviewing one key informant was a challenge due to non-response to the interview request letter.

In summary, the scope of the research is limited to the influence of informal small-scale water operators on water service delivery in Mukuru Kwa Njenga settlements.

1.6 Definition of Key Concepts.

Water service delivery refers to the frequency of access to clean water within the last 12 months in the settlement.

Informal settlements are unplanned urban residential areas, often developed outside the legal framework. They are often characterized by inadequate access to major services such as water supply and electricity, among others.

Water source refers to the main water access points for the informal water operators within the settlements.

Informal small-scale water supply system refers to informal settlements' non-conventional water provision systems.

CHAPTER 2: LITERATURE REVIEW

2.1 Theoretical Framework: The Living Conditions Diamond Framework.

This framework was developed in the 2007 and 2008 writings by Talukdar and Gulyani and is graphically represented as a diamond with four dimensions (Gulyani et al., 2012). The framework provides an in-depth understanding of the settlement quality and the key dimensions that act as entry points for interventions to improve or alter a settlement's living conditions (Gulyani & Bassett, 2010). The four components arrayed in the vertices are infrastructure, tenure, unit, neighborhood, and location (Gulyani & Bassett, 2010). These elements interact and collectively influence each other and thus should not be considered separately.

Tenure is an individual's right to hold a piece of land. Tenure acts as a minimum condition for medium and long-term investments. The key characteristics of tenure affecting living conditions include the *type of tenure*, which is categorized into occupancy and ownership. In literature, ownership is associated with improved living conditions, as owners tend to have the prerogative of improving neighborhood quality and housing units. The second aspect is *formality* which pertains to the state's formal recognition or recording of the tenure right as an ownership deed or rental lease. The third component is the *surety of tenure* of tenants and the land/structure owners; the state will not evict them at any given time. The fourth aspect is the *tenure mix*, which estimates the proportion of residential owners and tenants and their level of empowerment to advocate for better service provisions. The final component under tenure is the *duration of stay*. People who stay long in a particular space tend to form strong links and are likely to demand better living conditions than transient residents.

The second dimension of the diamond framework is **Infrastructure**, which includes the physical stock and assets such as water supply and other service provisions that enhance the settlement's functionality. The settlement's water access level constitutes service, coverage, affordability, and reliability (Gulyani & Bassett, 2010). Expansion of service *coverage* in the settlement involves the construction of water mains and actual household connections and use as a primary source. *Level of service* refers to the quality of service provided to informal residents. The third aspect is *reliability*. It refers to the availability of water when needed by consumers. Lastly, *affordability* will either lead to the actual use of the primary water source or supplement with alternatives from other sources.

The third component is the **unit**. Two major characteristics determine the unit quality, these are: structural integrity or building materials and overcrowding or density. The *building materials* determine the unit standards and its ability to withstand, for instance, climate extremes. To determine the unit standards, roofing materials, foundation, and exterior walls should be measured and categorized as made of permanent or temporary materials. The second aspect, *overcrowding/density of occupancy*, detracts from living conditions in informal settlements in various ways, especially in underserved settlements (Gulyani & Bassett, 2010). Person per room and room per household are employed in measuring overcrowding/ density of occupancy.

The final dimension is **neighborhood/location**. According to (Gulyani & Bassett, 2010), the physical layout, spatial location, density, amenities, and circulation influence living conditions. The *spatial location* constitutes the centrality or how the settlement structured (connectedness) and environmental or physical vulnerability. Centrality is the settlement's location to socioeconomic activities and facilities to ease access, such as jobs, markets, and schools. The spatial location is also related to physical or environmental vulnerability. Residents in vulnerable areas often bear the cost of bad location, for instance, infections resulting from water contamination in informal and other settlements. The second neighborhood aspect refers to the physical planning indicators: circulation, density, and physical layout (Gulyani & Bassett, 2010). Physical planning in settlements is critical in managing population density per acre, providing a layout for service delivery, and ensuring basic circulation. For example, the layout of the water supply infrastructure and circulation within the settlements to households are important to ensure domestic water delivery and use. Urban informal settlements are often located in precarious locations and thus are unlikely to benefit from physical planning (Gulyani & Bassett, 2010).

As applied in the study, the interactions between the four vertices are suspected to influence water service provision in informal settlements. The interactions within the four dimensions have been provided as a basis for altering/ improving living conditions. Changes in a particular dimension lead to changes in other framework dimensions. Understanding living conditions further calls for knowledge on who lives in a particular settlement, the activities they take part in and the dynamics. Therefore, the employment type and education levels were incorporate in the study framework to understand their influence on living conditions. According to (Gulyani & Bassett, 2010) unemployment often results to increased poverty rates, thus leading to poor living conditions.

In the study, the living conditions are predicted to influence water service delivery, coupled with the characteristics of the informal water operators, such employment type and education levels

The limitation fails to isolate the causal variables that explain the good or bad conditions in the settlement; these factors are considered to lie outside the framework, such as policy frameworks guiding service provision (Gulyani & Bassett, 2010).

2.2 Empirical Literature Review.

2.2.1 The Vendor Source of Supply in Urban Slums.

The section examines the available water sources for water providers in urban slums.

Mapunda et al., (2018b) adopted a mixed-method technique to assess the role of informal water supply systems, state, and inherent practices in addressing drinking water shortages in peri-urban Dar es Salaam and stakeholders' and consumers' attitudes towards the system. A total of 183 respondents participated in the interview process: 77 were from Mkondogwa of Chimanzi, 41 from Kifulu of Kinyerenzi, and 65 from Muungano of Goba. Using the number of households served, a purposive sampling technique was adopted to select well operators. The study employed structured and open-ended questionnaires to facilitate data collection at the household level. The study also included key informant interviews. The three KI were purposely selected from the three sub-wards, and data collection involved the use of semi-structured and open-ended questionnaires. Critical observations were photographed and recorded (Mapunda et al., 2018b). Data analysis involved data summation into themes as observed. The study findings indicate that wells had become defacto small-scale utilities in the study settlements. Groundwater was the most used, accounting for 94% of drinking water, with deep wells accounting for 84% of consumption.

About 7.8% of the respondents consumed drinking water supplied by tanker trucks, with 1000 to 3000 cubic meters drawn from deep wells or DAWASCO. Also, 21.8% of Muungano and 30.3% of Kifulu poor households consumed drawn water from the open wells. About 10% and 33% of proprietors in Kifulu and Mkondogwa had wells fitted with generators to sustain water supply. 28.8% of the study respondents had pipe connections. Mkondogwa has a significant number of households' pipe connections at 46.2%, with the least being Kifulu at 12%. Pushcarts and bicycle vendors were common and supported livelihoods in Mkondogwa. About 15.4% used them as a means of water access. They mainly served food vendors, bars, and mini restaurants. Water prices

varied between the sub-wards. Kifulu had higher price variations per 20 liters than Mkondogwa and Muungano sub-wards, but its monthly charges were slightly lower.

Dakyaga et al., (2018) used the mixed-method approach to examine domestic water access sustainability under an informally driven water supply market. The study draws more on qualitative data to gain insights into access to water today and tomorrow. To ensure equal chances of selection, a multi-stage sampling criterion was adopted. Based on the 2012 data from the Tanzanian Bureau of Statistics Report, the municipalities were categorized and analyzed per the planning status and prevalence of the informal market operations. The three study areas in Goba were; Chaurembo, Kunguru, and Kibululu, were randomly selected. Data collection took place between July and December 2017. It was divided into three levels: community-level interviews with water supply operators, institutional with the municipal water engineers and ward leaders, and community-level surveys with the selected households. The study sample was 292 households, including three mtaa leaders, MWE, 43 informal water supply actors, and a ward health officer. Surveyed households were randomly selected. Semi-structured questionnaires were employed to collect the primary field data. Qualitative data were transcribed and categorized into various themes, and survey data was edited for accuracy and analyzed using SPSS version 20.

From the study findings, tanker trucks were the most patronized and were found to supply water to the largest portion of the study population. These include 52.1% of high-income, 65.7% and 38.3% of middle income and low-income households, respectively (Dakyaga et al., 2018). About 26.4% of low and middle-income residents sourced water from private taps, 14.6% of low-income residents habitually depended on pushcarts, and only 11.5% relied on mechanized boreholes since they could not finance the cost of pipe extension. Vendors appropriated water from boreholes or public water reservoirs. Despite the spatial accessibility of water kiosks in the studied settlement, only 21% of the surveyed households depended on them. The perceived poor water quality hindered high-income households from habitually depending on water kiosks. In addition, the water stored for sale, the consumers' value for the water, the distance during transportation, and the season determined the cost of water in the studied settlements.

(Sarkar, 2020b) using a mixed-method approach, examined the informal water market operations and how it serves the urban residents in Mathare informal settlement, Nairobi. This study took

place between 2016 and 2017. Primary data was collected through structured questionnaires from 258 randomly selected households and key informant interviews with 20 water vendors, government officials, and participant observations. Data was obtained from multiple sources to enhance the validity and reliability of the findings.

The study results show that only 10% have municipal water connections on their premises. Over half of the slum dwellers were supplied by the informal operators, and about 36% of the respondents depended entirely on informal water providers for their domestic water needs. The presence of water vendors was significant even in areas with water ATMs. 14% of residents living in these areas purchased water from vendors. Poor households bought water more often than the high and middle-income households. Half of the urban poor households depended on small-scale water providers, with just 32% of the upper-class residents depending on the same water providers. Water vendors obtained water by buying from water standpipes or ATMs, rivers, and wells or illegally cutting into municipal pipes. About 46% of respondents confirmed that vendors purchased water from standpipes, 33% did not care where vendors obtained water, and 12% did not have source preference. Also, the availability of an alternative water source and the settlement location determined the cost of water per 20 liters of jerrycan. In other words, vendors' profits depended on the market forces and water source. The vendors' estimated profit was 99% to 75% if they purchased water from an ATM and more if obtained illegally from the mains.

Using a mixed-method approach, Braimah et al. (2018) investigated the prevalence associated with water supply in Ghana's three informal settlements from informal water vendors. The study was conducted between July and September 2013. La Old Town, Adenta, and Akweteman settlements were selected for the research study. Data was collected from 78 water vendors: 53 fixed-point vendors (boreholes, reservoirs, and public standpipes) and 25 mobile water providers (cart and truck water suppliers) using the survey questionnaires administered by the researcher. As part of the study, key informants were purposively selected, and data was obtained through focus group discussions and informant interviews. These include policymakers, policy implementors, and other urban water supply sector informants. The focus group discussions had 8 participants each, comprising opinion leaders and women's groups. Participant selection criteria were applied based

on their duration of stay and the water source type. Descriptive analysis was employed for the quantitative data, and content analysis for the qualitative data.

The results revealed that vendors primarily obtained water from the country's utility's main and water vendors who collected water from private boreholes located outside the study areas. Households in water-stressed settlements obtained water from mobile vendors, who collected water from small-scale water operators. The long queues at the utility main explain the mobile vendor preference for the small-scale providers. Despite the municipal assembly's effort to construct a borehole in Akwetaman to serve as an alternative source and sustain residents during interruptions, water vendors supplied water to the community's reservoir. The cost of water was determined by 20-litre jerrycan, water source, availability, and transportation. Mobile water vendors had the lowest price variance, with a minimum and a maximum of (GHp) 16 and 29, respectively (Braimah et al., 2018). The fixed-point vendors had a price differentiation of (GHp) 10.00 to 50.00 as the maximum.

Using primary data from a cross-sectional study targeting 11 informal settlements in Nairobi City County in 2017, (Wagala, 2020) employed a quantitative strategy to examine the role of living conditions on domestic water access in four urban slum areas: Mathare Mashimoni, Kosovo, Mathare 4B, Mathare 4A, with a study sample size of 521. The initial study adopted circular systematic random sampling as a criterion for household selection. Survey questionnaires were administered to the selected households. Also, focus group discussions were conducted with the community and stakeholders in the studied settlement.

Using SPSS v22, the study conducted a descriptive, bivariate, and regression analysis to determine the causations in the key study variables. The findings show that water sources differed within the studied households. 60.1% of the study respondents obtained water from the water kiosks, 34.8% consumed water obtained from compound taps, 4% obtained water from individual connections to water pipes, and 1% used other sources to obtain water. Additionally, 45.5% of the respondents indicated that they had gone several days without water in the past 12 months, while 54.5% claimed they always had water (Wagala, 2020).

2.2.2 The informal water supply challenges.

(Mapunda et al., 2018b), in examining the role and practices of the informal water providers in addressing domestic water shortages in peri-urban areas of Dar es Salaam. Topography, water availability, population density, and settlement type were found to limit the operations of water vendors. Residents in sparsely populated settlements had restricted access to deep well piping, whereas access was within a 100-300m distance in densely populated areas. Also, the need for more technical support from designated authorities in deep well construction was noted as a significant challenge. About 95% of deep wells did not undergo water quality tests. About 56% of deep well appropriators assessed water quality based on salinity levels and appearance. The lack of support was partly due to negligence and a lack of awareness of the significance of water quality as an important aspect of drinking water. Furthermore, the proximity of wells to sanitary facilities led to the risk of groundwater pollution. 70% of the boreholes in Kifulu and 65% in Muungano sub-wards were constructed at lower altitudes.

Braimah et al., (2018)) investigated the prevalence of poverty penalty associated with water supply to the urban low-income residents in Ghana from the informal water providers. About 50% of vendors acknowledged that water insufficiency was a significant challenge. However, vendors' experiences varied in relation to supply challenges. Mobile water vendors were distressed by the long distances to the water source and the long queues at the loading sites. The time spent at the filling stations made them source water from boreholes. Water unreliability from the utility mains affected water sales by standpipe and mobile water vendors. About 12% of cart operators complained of the cumbersome nature of cart registrations. Lack of registration was presented as a reason for police harassment. Also, 89% of water truck operators, 14% of tanker operators, and 67% of water cart vendors were extorted by the Ghana police service. Besides supply challenges, the high cost of water, poor quality, and the client's debts, especially from family members were identified as critical challenges in the study. About 35% of standpipe and 35% of reservoir operators, who seldomly relied on mobile vendors for service, mentioned the bulk cost (transport, operational, and profits) from mobile vendors as a significant challenge.

Using primary data from a cross-sectional study targeting 11 informal settlements in Nairobi City County in 2017, (Wagala, 2020) employed a quantitative strategy to examine the role of household living conditions on domestic water access in four urban slum settlements: Mathare Mashimoni, Kosovo, Mathare 4B, Mathare 4A, with a study sample size of 521. The initial study adopted circular systematic random sampling for household selection. Survey questionnaires were administered to the selected households. Also, data collection involved focus group discussions with selected residents and other stakeholders in the settlement. The study findings reveal that 76% of the population identified flooding in the settlement as a problem. This is because environmental conditions/location of the settlement were found to have a significant effect on the establishment and the sustenance of water supply infrastructure, thus affecting domestic water access (Wagala, 2020).

2.2.3 Households' Perspectives of Water Access under the Informal Water Providers.

(Dakyaga et al., 2018), drawing on the supplier-consumer perspective, used a mixed-method approach to examine the sustainability of domestic water access under the informal markets in Kibululu, Chaurembo, and Kunguru, Dar es Salaam. According to the study findings, the absence of regulatory frameworks guiding the existence and entry has significantly contributed to the proliferation of informal water providers and flexibility in service delivery. Clients receive home deliveries from tanker and pushcart water sellers. High, middle, and low-income households obtained water from varied distributors within a 200m distance, with 77.4%, 77.6%, and 79.9% of households in each income group, respectively, obtaining water from the identified sources. Nevertheless, the cost disincentivized domestic water access. About 29.1% of household respondents could not purchase sufficient water due to cost implications. Also, frequent water purchases affected household medical access. About 17.9% of respondents indicated that frequent water purchases affected their ability to access proper medications. The in-marginality of prices from the water kiosks, pushcarts, and mechanized boreholes reduced households' budgetary commitments to equally significant necessities such as health (Dakyaga et al., 2018). Seasonal variation was found to have implications for domestic water access in the informal driven markets. In dry seasons, the erratic supply, coupled with the long transportation, often led to water contaminations through the ingress of particles in water, making it unsuitable for consumption. As a result, 88.3% of households boiled the water, and 6.8% filtered the water supplied by vendors.

Despite the procedures, about 48.7% of the residents suffered from typhoid, 21.3% from cholera, 30% from diarrhea, and 8% could not mention the name of the infection.

Mapunda et al., (2018b) employed a mixed-method technique to examine informal water supply systems' role, state, and inherent practices in addressing drinking water shortages in Muungano, Kifulu, and Mkondogwa. The study results show that the residents were optimistic. 64% of households across the studied wards acknowledged the significance of water vendors in meeting their drinking water needs. Despite that, only 23% of the residents accepted the system, with the rest being receptive. 60% of households across the studied wards revealed excellent water quality, particularly in Muungano and Mkondogwa. Residents in Kifulu wards reported that the water quality was poor. Nevertheless, over 45 percent of households across the studied settlements consumed drinking water without prior treatment.

Sarkar, (2020b) employed a mixed-method approach to determine the functioning of informal water markets and how they serve the residents in Mathare slums, Nairobi. The study draws on vendor-client perspectives. The findings reveal the injustices resulting from the residents' exclusion from the utility's main supply and vendors' failure to deliver water reliably. Clients perceived water vendors as significantly contributing to the scarcity problem due to service unreliability. About 89% had no choice of timing and depended on the supplier's timings. Vendors' lack of scheduling made the residents miss work, jeopardizing their income sources as they had to wait for the vendors. Also, most clients seemed uninformed about the quality of the water purchased. Approximately 33% of the households did not care or even know where vendors sourced the water. About 12% of the population sourced water from various points. Furthermore, clients noted the unwillingness of vendors to provide such information as it always resulted in fights and threats to stop selling them water.

Braimah et al., (2018) used the convergent parallel mixed-method approach to examine the community's perceptions of informal water vendors in three informal settlements in Ghana. As per the findings, most households attributed the improved access to the vendors' initiative in water service delivery. Nevertheless, they lamented the high-water prices, stating that water charges were up to 42 times more than the country's utility tariff of GHp 1.68 (Braimah et al., 2018).

Additionally, the study respondents were concerned about the quality of water sold. In Old Town, water quality was as the second most significant challenge in the area. Most residents maintained that they relied on informal water vendors because of non-access to the main supply.

2.2.4 International Standards on Access to Water.

The General Comment No. 15 of the United Nations Committee on Economic, Social and Cultural Rights sets out the legal basis of the right to water (UN CESCR, 2002). It states that each person has the right to sufficient, physically accessible, safe, affordable, and acceptable water for domestic and personal use (UN CESCR, 2002). **Sufficient:** Each person is entitled to 50 to 100 liters daily to meet their water needs (WHO, 2011). **Safe:** Water supply fit for human consumption; the water should be free from micro-organisms, radiological hazards, and chemical substances that threaten human health (WHO, 2011). **Acceptable;** the taste, color, and odor must be acceptable for domestic and personal use. Also, it has to be culturally appropriate and gender-sensitive (WHO, 2011). **Physical Accessibility:** Water access facilities must be within or in the individuals' immediate environment (UN CESCR, 2002). According to (WHO, 2011), the water source must be within 1km (1000m) of the home with no more than 30 minutes of collection time. **Affordability:** Each person should be able to afford water at a cost that does not affect their ability to acquire other goods and services, such as food. This should not exceed 5% of the individual's household income (WHO, 2011).

2.2.5 Legal Framework on Water Service Provision in Kenya.

In Kenya, water vending is primarily a grey area, and there is no specific policy in place for regulation; hence, the regulations governing the sector are inferred from the existing legal framework.

2.2.5.1 Existing Legal Framework.

The Kenyan government instituted a series of reforms, one of which is the devolution framework to regulate water provision and access in the country. Initially, supply was a prerogative of the municipalities (Boakye-Ansah et al., 2019a). During this period, supply in urban slums was characterized by high levels of non-revenues and non-payments. The reforms gained momentum following the publication of Sessional Paper No.1 of 1999, majorly driven by the shortcomings of

the previous set-up (Owuor & Foeken, 2009). According to (Shurie et al., 2017), the Sessional paper addresses the limitations of the Water Act Cap 372, which had failed to recognize the community and informal water supply provisions. The objectives of the Sessional paper found a legislative basis in the Water Act 2002. The Act introduced several legislative changes within the sector. It separated water service provision and water resource management. It led to the establishment of the WRMA to govern water management, WASREB to oversee sewerage and water provision in various jurisdictions. Similarly, the WSTF was mandated to organize financial support for water projects (Sambu & Tarhule, 2013). Also, it led to the establishment of the NCWSC as an autonomous utility responsible for water provision in Nairobi, including informal set-ups (WSUP, 2018). The Water Act of 2002 was applauded for its noticeable achievement, including creating an ISD within the NCWSC. By 2018, the Informal Settlement Department had operational offices in Kayole, Mukuru, Kariobangi, Soweto and Kibera to facilitate water service improvements for the residents (WSUP, 2018).

The 2016 Water Act replaced the repealed 2002 Water Act. The essence was to align the new Act with the country's constitutional mandates. It reflected the newly devolved structures, including the realization of the rights of Kenyan citizens enshrined in Article 43 (1) of the COK, 2010 (Boakye-Ansah et al., 2019a). Kenya's Vision 2030 and SDG 6:1 supports universal access to water, which seeks to achieve 100% safe water coverage and sanitation services by 2030 (WSUP, 2018). Also, under section 70 of the Water Act, WASREB is mandated to protect the rights and interests of consumers in providing water services, including informal residents (WSUP, 2018). As part of the devolved system, the WSPs became the responsibility of the newly formed County government and obtained licenses from WASREB (WSUP, 2018). Also, the Water Services Trust Fund was renamed the Water Sector Trust Fund, which became a financing institution with an expanded role to collaborate with Water Resource User Associations (WRUAs) and the County governments to provide water services in underserved areas (WSUP, 2018).

The legal framework has created spaces for funding and water service delivery. However, the inefficiency and general inability of the water utilities to sustain demand have led to the growing unserved population, particularly in informal urban areas, where water supply is still a challenge.

2.3 Conceptual Framework.

The conceptual framework shows the interaction between the key study variables. Water service delivery within the past year is the dependent variable. The dimensions of the living condition diamond framework influence service delivery in the slum areas; these constitutes the independent variables. The dimensions of the living diamond framework include: tenure, environmental conditions, employment type, household size, water source (infrastructure). The institutional framework is the intervening variable between informal small-scale water supply systems and water service delivery.

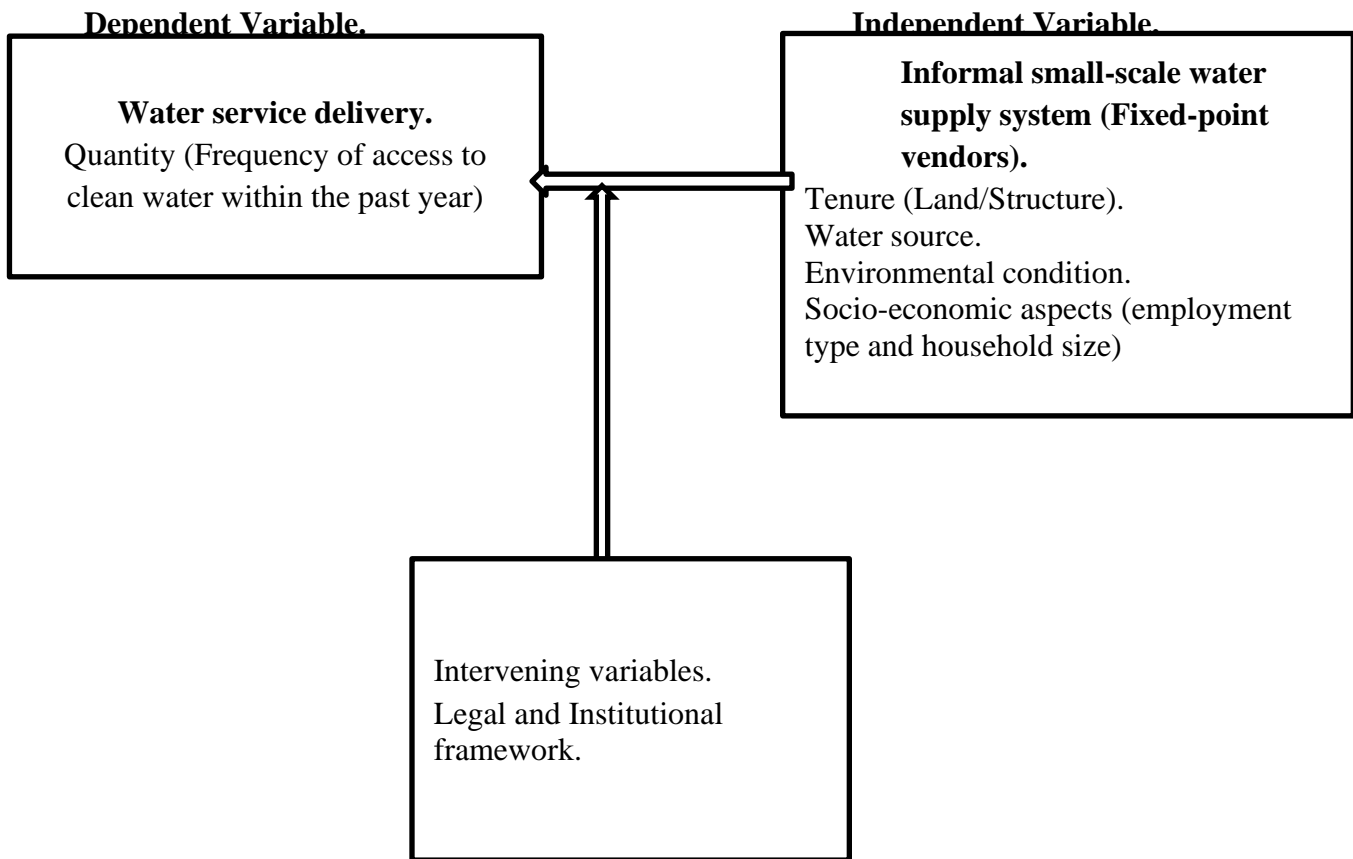


Figure 1. Conceptual Framework.

CHAPTER 3: RESEARCH METHODOLOGY.

3.1 Introduction.

Research Methodology is defined as the science of studying how a research is scientifically conducted (Kothari, 2004). It entails techniques for studying a research problem and the logic behind the particular problem. This section of the study will provide an in-depth discussion of the research design, study site, study population, along with the target population, sampling techniques employed, data collection procedure, and analysis.

3.2 Research Design.

Bryman, (2012) defines a research design as a framework for evidence generation suited for data collection and analysis. These designs include cross-sectional or survey, longitudinal, case study, experimental, and comparative research design. The choice of the design chosen, reflects the priority given to the dimensions of the research process, such as the temporal appreciation of the social phenomenon and causal relationships, among other factors (Bryman, 2012).

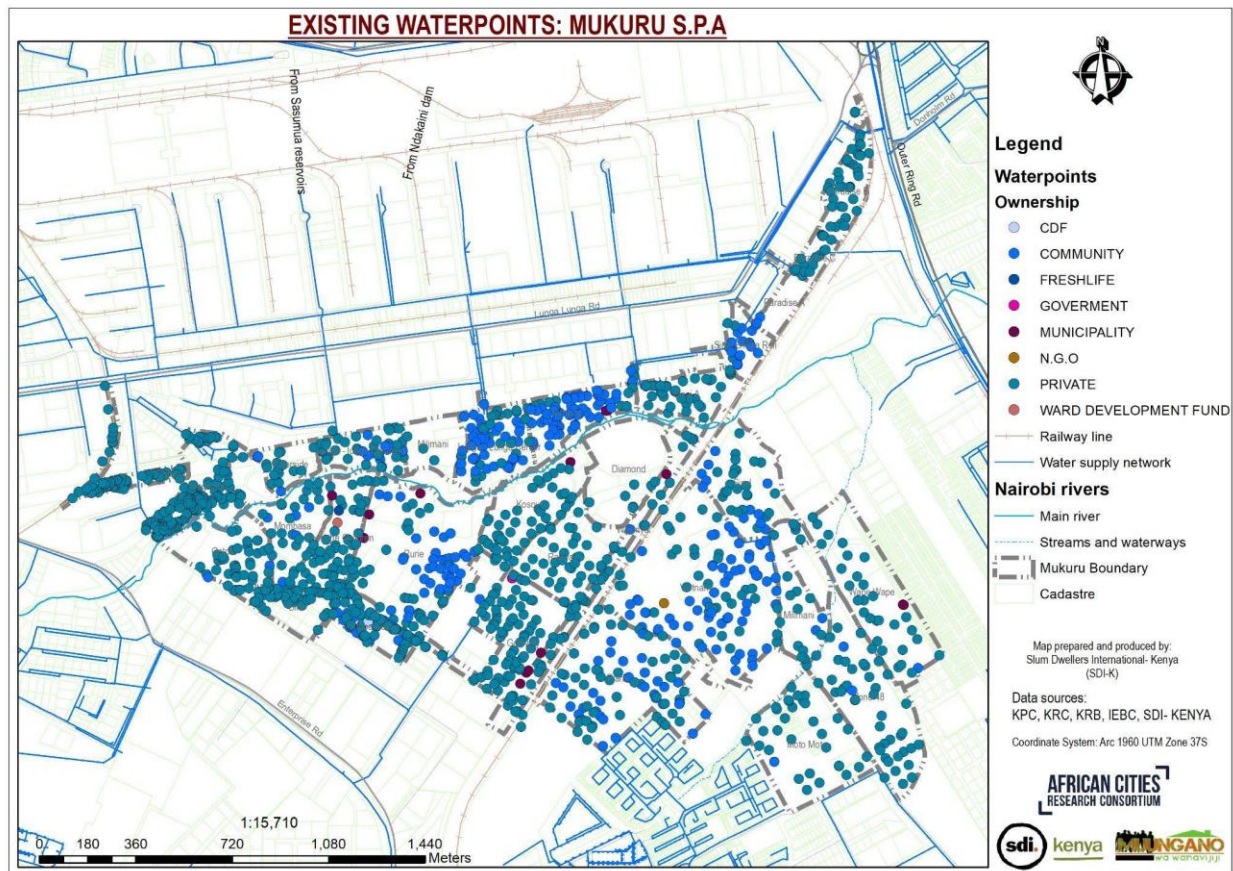
This study used the cross-sectional design since it involved data collection on a set of variables at a single point in time (Bryman, 2012), given the limitations highlighted by the previous studies on the challenges of obtaining information from water vendors (Sarkar, 2020b; Wutich et al., 2016). The study employed a mixed-method research strategy to allow for triangulation to enhance the validity and credibility of the findings. In the quantitative strategy, structured household questionnaires were administered to obtain data on household demographics, water access approaches, and perceptions of informal water vendors, as well as informal small-scale water operators. The qualitative strategy employed the use of interview guides, administered to key informants (purposively selected knowledgeable respondents) in the study area.

3.3 Study Site.

Mukuru is one of the largest slums on the southeastern side of Nairobi in the Embakasi sub-county, Nairobi City County. It has an estimated population of 301,683 with 100,561 households (Corburn et al., 2017). The population is projected to rise to 682,076 by 2030 at an annual rate of 6% (Corburn et al., 2017). The railway line divides the slum into two sections: Mukuru Kwa Njenga to the east and Mukuru Kwa Reuben to the west.

The study site was Mukuru Kwa Njenga. Water access in the area is insecure. Empirical evidence shows that water in the slums is majorly supplied by water vendors (Usuk, 2015). Only 1% of households in Mukuru slums have access to an individual water source (Corburn et al., 2017). The choice of the study area was influenced by the existence of informal water markets in the settlements and its positioning as a low-density settlement with few or no public water points (Corburn et al., 2017).

Figure 2. Location of the map showing the water points and sanitary points.



Source: SDI (2023).

3.4 Target Population and Population for the Study.

The research study targeted informal water operators as the unit of analysis. The aim was to assess the tenure characteristics, socio-economic characteristics, environmental conditions, and infrastructure on domestic water service delivery in Riara, Vietnam, and Wape Wape settlements in Mukuru Kwa Njenga.

3.5 Sampling.

The study used mixed-method sampling to identify sample respondents. Non-probability sampling technique was used in identifying the qualitative strand. The qualitative strand employed purposive sampling to select the study settlements: Riara, Wape Wape, and Vietnam. The settlements were purposively selected due to the presence of informal water operators, as highlighted in the empirical literature (Usuk, 2015). Purposive sampling allows the researcher to use cases in line with the study objectives (Mugenda & Mugenda, 2003). Additionally, the study key informants were selected using purposive sampling. The selection involved having one key informant in each study area, and two institutional representatives: Muungano Alliance and NCWSC.

The study households were selected using a probability sampling technique to ensure that each unit in the population has a known chance of being selected for the survey study (Bryman, 2012). The study used Fishers' formulae, as quoted by (Mugenda & Mugenda, 2003), to determine the sampled households for the survey.

That is $n = Z^2pq/d^2$ (Mugenda & Mugenda, 2003).

Where:

n is the desired sample size if the target population is > 10,000.

Z is the normal standard deviation (1.96) corresponding to a 95% confidence level.

P is the proportion in the target population estimated to have the characteristic (assume 50% if unknown).

Q is (1-P).

D represents statistical significance (0.05).

Therefore, $\{1.96^2 \times 0.5 \times 0.5\} / 0.05^2 = 384.16$.

The study sample size was 384 households.

A stratified random sampling technique was used to categorize the selected informal settlements into separate strata to ensure proportionate representation. That makes 384 divided by 3 settlements. Due to the researcher's financial constrain and time, the study surveyed 105 households.

Due to inadequate information on the number of informal water operators in the settlement, a transect method was used in the reconnaissance survey to map the operators along the settlements' streets. As a result, 67 informal small-scale water operators were interviewed for the study.

3.6 Planning for Key Informant Interviews.

The key informants were identified through the literature review process. A request letter was sent to the study's key informants, followed by calls to help schedule the interview time. The response rate was 99%.

3.7 Data Collection.

In literature, scholars (Braumah et al., 2018; Sarkar, 2020b; Wutich et al., 2016) have noted the difficulty in studying the informal small-scale water supplier. As a result, data was drawn from multiple sources to enhance the validity and reliability of the research findings.

Before the actual data collection, a pre-test was conducted on 24 August 2023 in Milimani settlement, Mukuru Kwa Njenga. In the pre-test, two households and two informal small-scale water operators were interviewed to test the applicability of the questionnaires and possible updates to suit the study objectives.

The actual data collection took place as from the 28th of August to the 17th of September. Data collection within the household level involved the administration of structured questionnaires to obtain data on the state of water access in the settlement and their perceptions of the informal water operators. The informal small-scale operators were interviewed on the aspects of their living conditions to determine the influence of domestic water delivery in the study areas. These were

done simultaneously. In the final stage, the researcher conducted key informant interviews with the selected informants using key informants' interview guides.

For the observations, the researcher walked around the study settlements, talked with the residents, and observed the interplays between the informal small-scale operators and household water consumers. The objective was to identify patterns not easily detectable in the interviewing process.

3.8 Data Analysis.

The data collection process generated quantitative data and qualitative data. The quantitative data was used to determine the correlation between the study variables. To show the relationship between the variables, bi-variate analysis involving cross tabulation was done with the Pearson Chi-square test, contingency tables, and Cramer v test. The Chi-square test was done to understand whether there were variations in domestic water service delivery by the independent variables for the study. The collected data was cleaned in Excel and analyzed using SPSS version 20.

Qualitative data was transcribed and analyzed per the study themes identified during the literature review. The analyzed data has elaborately been presented through tables, graphs, and cross tabulations in chapter four of the research paper.

CHAPTER 4: THE STUDY FINDINGS AND DISCUSSIONS.

4.1. Introduction.

The overall objective of the research study was to determine the influence of the informal small-scale water supply on water service delivery in the Mukuru Kwa Njenga settlement. The specific research objectives were to establish the water source used by the informal small-scale water suppliers, to analyze the challenges experienced by the informal water suppliers, and to determine the influence of the informal water suppliers on water service delivery in the study settlement. The study employed descriptive statistics to understand the sample characteristics and inferential statistics to assist in making inferences about the larger population from which the study sample was drawn. The study focused on three informal settlements: Riara, Vietnam, and Wape Wape within Mukuru kwa Njenga, Nairobi City County. From the field data collection, 105 households, 67 informal small-scale water suppliers, and 4 key informants were interviewed for the study.

4.2 Descriptive Data Analysis.

The field data collection involved obtaining data on the respondents' socio-economic and demographic profiles to provide an in-depth understanding of the sample characteristics. These are discussed and presented in frequencies and percentages and further interpreted in relation to other scholarly studies.

4.3 Characteristics of The Study Sample.

4.3.1 Respondents' Gender.

Table 1. **Gender of the Informal Small-scale Providers.**

	Frequency	Percent
Female	26	38.8
Male	41	61.2
Total	67	100.0

Source: Field Data (2023).

Table 1. on the respondents' gender indicates that 61.2% of the informal water suppliers in the study settlements are male, followed by 38.8% females. The dominance of men in the vending enterprise is attributed to its laborious nature (Braithwaite et al., 2018). The household's respondents

highlighted that water vendors spent most of their time pumping water and ensuring continuous water flow at the standpoints. The findings on the predominance of males in the water vending enterprise are consistent with the study findings reported by (Ahmad, 2017; Braimah et al. 2018; Dakyaga et al., 2018).

Regarding gender distribution in the study settlement, there was a slightly marked difference in proportion per settlement. However, the overall distribution highlights the dominance of men in the vending water enterprise.

*Table 2. Respondents Gender. * Settlement's Name Crosstabulation*

		Settlement's Name			Total
		Riara	Vietnam	Wape	
Respondents Gender.	Female	13	5	8	26
	Male	12	20	9	41
Total		25	25	17	67

Source: Field Data (2023).

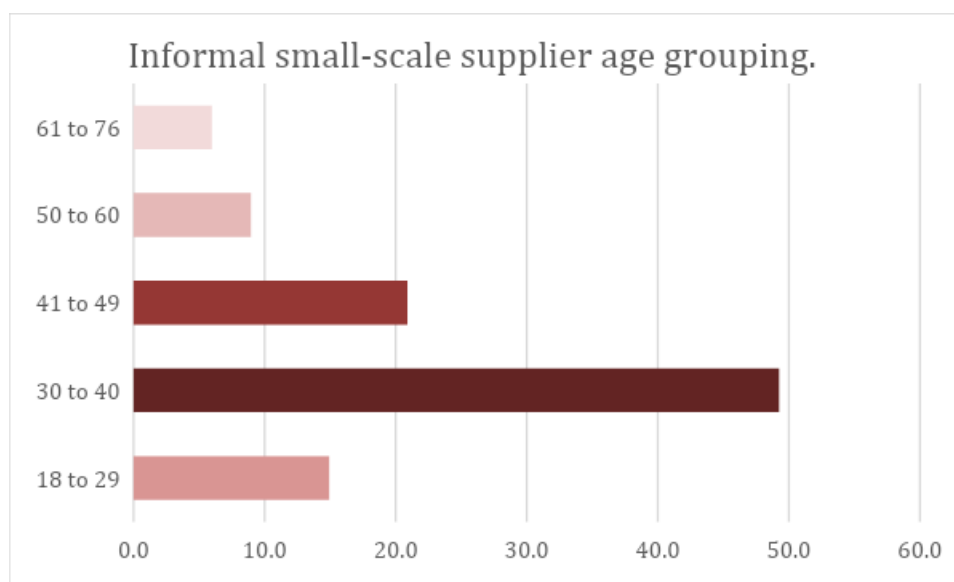
With regard to household respondents' gender, most of the interviewed respondents were women 90 (85.7%), followed by 15 (14.3%) males. The high rate of female respondents in the study settlement is attributed to most women being at home during the interview, with a few others running their businesses just next to their residents. The study findings are consistent with other scholarly study findings; out of 183 household respondents surveyed in three settlements, 60.1% were females, followed by 39.9% males; 149 (51%) females out of 292 respondents, followed by 143 (49%) males; and out of 517 respondents interviewed four informal settlements in Nairobi City County, (325) 62.9% were females, followed by (192) 37.1% males (Dakyaga et al., 2018; Mapunda et al., 2018a; Wagala, 2020), respectively.

4.3.2 Respondents' Age.

Figure 4 shows that 49.3% of the informal small-scale suppliers are within (30-40) years old, with the least at 6% (61-76). A higher proportion (64.2%) _a composition of (18-29; 30-40) of the

informal small-scale suppliers were younger. The findings can be attributed to the laborious nature of the enterprise. Also, the interviewed households had a similar age pattern. 38.1% of the respondents were between the ages of 30 and 40, with 32.5% of the older population being 50 to 76.

Figure 3. Age grouping.



Source: Field Data (2023)

4.3.3 Household sizes.

According to (Wagala, 2020), household size influences the quantity of water sourced and what is consumed within the household.

Table 3. Informal water suppliers: Household size

	Frequency	Percent
less than 3 people	15	22.4
3 to 5 people	29	43.3
more than 5	23	34.3
Total	67	100.0

Source: Field Data (2023)

Table 4. Household composition.

	Frequency	Percent
less than 3 people	36	34.3
3 to 5 people	50	47.6
more than 5 people	19	18.1
Total	105	100.0

Source: Field Data (2023)

Figure 5 indicates that the largest household for those operating in the informal water markets had a composition of 3 to 5 people at 43.3%, with the least less than 3 people at 22.4%. For the households, the largest household size was about 3 to 5 people at 47.6%, with the least household consisting of more than 5 people. The findings of the household size were found to be consistent with the study findings provided by (Wagala, 2020).

4.3.4 Employment Type and Monthly Income.

The employment type determines the household/individual's level of income. The income level will influence the quantity of water sourced and consumed within a particular household.

Table 5. **Employment type**

	Frequency	Percent
Casual employee	3	4.5
Regular employee	1	1.5
Self-employed	6	9.0
Selling water	57	85.1
Total	67	100.0

Source: Field Data (2023)

The results reveal that 85.1% of the informal water suppliers are full-time operators of the waterpoint, 1.5% are regular employees, and 9% are self-employed. The self-employed respondents were running their businesses alongside the water points. These involved selling vegetables, fruits, and foodstuffs (Githeri & beans). The water vendors at the settlement preferred

operating the waterpoints as opposed to employing someone since they were not considered trustworthy. The study findings correspond to (Ahmad, 2017; Braimah et al., 2018; Dakyaga et al., 2018) that water point operations remained a family business or managed by the owner. Of the 53 fixed-point water vendors interviewed (Braimah et al., 2018), 25 were operated by the owner, 16 relatives, and 12 employees.

On the income, the respondents were asked, on average, how much money they make per day from the water sales, which was then calculated based on the number of working days per week to obtain the monthly income range from water sales. From the field interview, the informal small-scale water suppliers made an average of 400 daily, and the least made Ksh. 200. This was different on Sundays as most could sell up to Ksh. 700 to 1000.

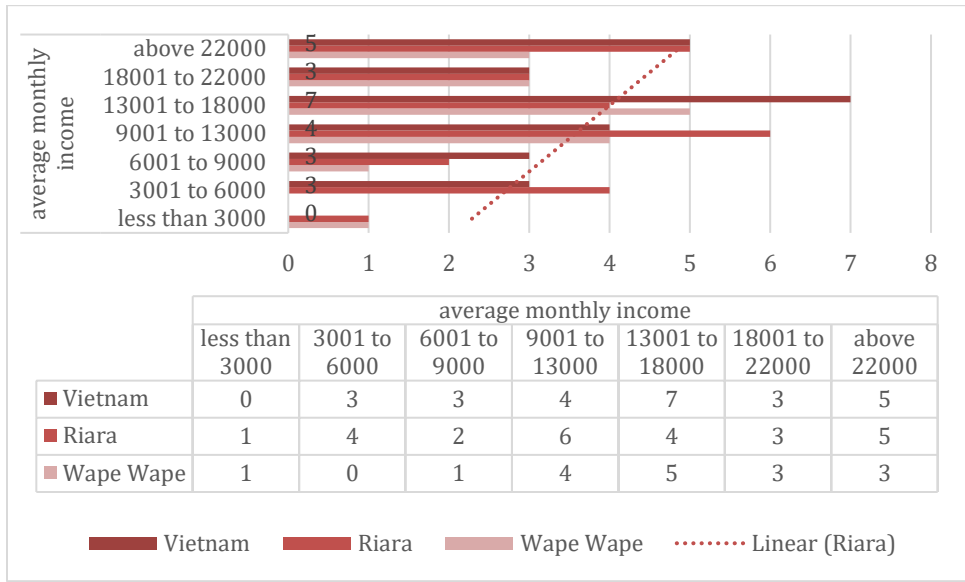
Table 6. Average Income.

	Frequency	Percent
less than 3000	2	3.0
3001 to 6000	7	10.4
6001 to 9000	6	9.0
9001 to 13000	14	20.9
13001 to 18000	16	23.9
18001 to 22000	9	13.4
above 22000	13	19.4
Total	67	100.0

Source: Field Data (2023)

From the table above, 23.9% of the respondents had an average income range of 13001 to 18000, with the least, 3% of the respondents making an average of less than 3,000.

Fig. 4.



Source: Field Data (2023).

The figure above represents the average income distribution across the study settlements. There was no significant variation between the three study settlements. Of the household respondents, 37.1% were self-employed, 35.3% unemployed, and 24.8% casual employees. In terms of average monthly income, 22.9% of the household respondents were within the range of Ksh: 3001 to 6000, and just 1.9% were above 22000 Kenya shillings. The study findings conform with the empirical literature (Mapunda et al., 2018a); the findings show that small businesses were the primary source of income for 67.2% of the household respondents.

4.3.5 Water Sources.

As discussed in the theoretical framework, water sources influence the functionality of informal settlements. The study findings reveal that 7.5% of the informal small-scale water providers have a private connection to piped water, followed by 92.5% using the water points within the study settlements. The Nairobi City Water Sewerage Company mainly provides water through the chamber model. The frequency of access depended on the different chamber locations; 38.8% of the informal water suppliers accessed water daily for 24 hours, with the least 4.5% accessing water daily for 24 hours. All the household respondents interviewed mainly sourced their water from the shared water points directly managed by the informal water suppliers, operating for about 12 hours a day, depending on water availability. This shows that most of the study population would suffer

from water deficits in the settlement without the informal water supply system. From a key informant's perspective, the informal water suppliers had stalled borehole constructions in Riara, thus making residents reliant on the water standpipes. Other reported sources, such as lined boreholes, were used in case of water scarcity.

From the empirical literature, the informal water system was the primary supply source to 94% of respondents in the study area (Mapunda et al., 2018a). Also, (Sarkar, 2020) found that half of the urban informal population in areas with no water ATMs depended on informal water markets.

4.3.6 Structure Tenure.

As discussed in the theoretical framework, the type of tenure affects the long-term investments in urban informal settlements. Given the sensitivity of the land issue at the time of the study, the researcher focused on identifying the tenure mix, duration of stay, and surety of tenure as opposed to identifying land/structure owners. The table below provides a descriptive illustration of the structure tenure in the study settlements.

Table 7. Structure Tenure

	Frequency	Percent
House owner	27	40.3
Tenants	40	59.7
Total	67	100.0

Source: Field Data (2023)

The results illustrate that 59.7% of the informal water supply system are tenants, with 40.3% being house owners. When the structure tenure is cross-tabulated against the duration of stay, it shows slightly higher counts of house owners within the stay duration of more than five years.

Table 8. Structure tenure by stay duration.

		Stay duration.			Total
		1 to 2 years,	about three years	more than five years	
Structure Tenure.	House owner	0	1	26	27
	Tenants	2	4	34	40
Total		2	5	60	67

Source: Field Data (2023)

4.3.7 Neighborhood and Location.

As discussed in the theoretical literature, the settlements' location directly influences the sustenance of domestic water delivery and use. The informal water suppliers were asked whether flooding within the settlement affects water service delivery. The results indicate that 46 (68.7%) confirmed that flooding affected water service delivery, followed by (21) 31.3% indicating that it was not a problem. The challenge was affirmed by 24 (22.9%) of the household respondents, indicating that flooding in the settlement washed away shallow pipes, and, at times, the pipes would burst, leading to water contamination.

Table 9. **Does flooding affect the water supply in the settlement?**

	Frequency	Percent
No	21	31.3
Yes	46	68.7
Total	67	100.0

Source: Field Data (2023)

4.3.8 Water Service Delivery.

Water service delivery is the dependent variable. It is defined as the frequency of access to clean water in the past year to enhance service delivery to the respective consumers. To estimate the quantity of water the informal small-scale providers accessed, they were asked how frequently the water was pumped to the main chambers. Table 10 illustrates the frequency of water access.

Table 10. **Frequency of water access.**

	Frequency	Percent
always have water	37	55.2
few days a week	30	44.8
Total	67	100.0

Source: Survey Data (2023)

The study findings indicate that 55.2% of informal small-scale supply systems always had water in the past year, whereas 44.8% had access to water in just a few days a week.

To determine whether the frequency of access by the informal small-scale water providers had a significant impact on household water access. Households were asked to estimate their daily water consumption; cooking, personal hygiene, washing, and drinking in liters. The table below illustrates the water consumption situation in the study settlements.

Table 11. An Estimate of HH daily water consumption in liters.

	Frequency	Percent
20	1	1.0
60	1	1.0
70	3	2.9
80	13	12.4
90	5	4.8
100	18	17.1
120	14	13.3
140	12	11.4
160	12	11.4
170	1	1.0
180	9	8.6
200	14	13.3
210	1	1.0
240	1	1.0
Total	105	100.0

The results of the quantity of water consumed in liters per day vary from 20 litres to 240 litres. 1% of the study population consumed a maximum of 240 litres per day, and 1% consumed the least 20 litres. 99% of the study population consumed more than 50 litres daily for their daily water needs. Water was available for an average of 12 hours daily; the informal water suppliers opened

at 6 a.m. to almost 8 p.m.; the water access point was locked after the day's operation. The residents collected water using buckets and jerrycans in less than 10 minutes. The cost of water varied depending on the season and storage quantity by the informal water suppliers. On normal days, 94 (89.5%) of the household respondents paid Ksh. 5 for a 20-litre jerrycan, with just 1% paying Ksh. 20 for a 20-litre jerrycan. During water-scarce periods, 53 (50.5%) of the household respondents paid Ksh. 10 for 20-liter containers, 32.4% bought water at Ksh. 20, and just 1% paid Ksh. 50 for a 20-litre jerrycan. On average, the sampled households spent 2.81% of their monthly income in normal seasons to purchase water, whereas, during water-scarce seasons, respondents spent 7.4% (7.365%) of their income to purchase water.

From empirical literature, access to water was within 100m of the primary water source (Ahmad, 2017; Dakyaga et al., 2018; Mapunda et al., 2018b). Seasonal variation affected the water prices, with about 65.8% spending more than 5% of their monthly income on water purchases (Mapunda et al., 2018b).

In terms of correlations, household size is positively correlated (0.275) with the quantity of water used; this was supported with a 0.05 level of statistical significance.

4.3.9 Descriptive Summary.

In summary, the descriptive findings show more male (61.2%) respondents than women (38.8) operating in the informal small-scale water supply market. The study finding is consistent with other empirical literature findings. The respondents were within the (30-40) age bracket, with a household size of 3 to 5 people at 43.3%. the descriptive findings of employment indicate that 85.1% of the informal small-scale water suppliers were engaged fully in the water re-sale venture, making an average of Ksh. 400 a day. Water was mainly obtained from Nairobi City Water and Sewerage Company. 38.8% of the study respondents obtained water daily from the service provider, lasting 24 hours daily. The result from structure tenure shows that 40.3% of the study respondents were house owners, followed by 59.7% tenants. Given the sensitivity of land at the time of the study, the researcher skipped the question on documentation as evidence for ownership. The settlements' environmental condition was found to affect water service delivery. The descriptive findings show that 68.7% of the informal small-scale suppliers reported flooding-affected water service delivery. This was affirmed by 22.9% of the households, indicating that flooding swept away pipes, leading to water contamination. On water service delivery, 55.2% of

informal small-scale supply systems always had water in the past year, whereas 44.8% had access to water just a few days a week. Additionally, household respondents accessed water within a reasonable distance; 100m to the water source, had 12 hours of water supply, and seasonal variations determined the water prices in the study settlements.

4.4 Bivariate Analysis.

According to (Bryman, 2012), Cramer’s v, Chi-square test, and contingency tables can be employed to determine the relationship between nominal variables. It was applied in the study to determine the correlation between the dependent variable and the predictors of water service delivery in urban slum areas. The table below illustrates the findings, interpreted at 0.05 as the statistical significance.

Chi-Square Tests between the dependent variable and predictors.

	Value	Asymp. Sig. (2-sided)
Tenure	9.764	.202
Environmental Condition	2.854	.898
Water source	12.588	.083
employment type	13.759	.880
HH	22.962	.061
N of Valid Cases	67	

The Chi-square test results reveal no statistically significant between the dependent variable and the predictors of water service delivery in the urban slum set-up studied. The p values as highlighted: tenure $p = .202$, household size $p = .061$, environmental condition $p = .898$, water source $p = .083$, and employment type $p = .880$, were >0.05 . This means that water service delivery did not differ by the different predictors in the study sample. The results for the non-significance level for employment type and household size are consistent with the empirical results: $p=0.480$ and $p=0.812$, respectively (Wagala, 2020)

4.5 Challenges of the Informal Small-Scale Water Supply.

The study findings show that the informal water supply operations respond to the settlements' water needs; however, they are limited by the settlements' conditions. Electricity, bursting of pipes, insecurity, and debts by clients were highlighted as the most significant challenges experienced by the informal water suppliers. 17.9% of the informal water operators indicated constant blackouts as a significant challenge, 14.9% mentioned bursting of pipes, 10% mentioned insecurity, and 17.9% highlighted debts by clients as a significant challenge. Of the households surveyed, 23.9% mentioned bursting of pipes as a significant challenge experienced by the informal small-scale water supply, followed by electricity at 21.9% and insecurity at 7.7%.

“In the absence of electricity, vendors are unable to pump water from the chambers to the water stands. Therefore, access becomes a challenge as we have to wait for power, and at the same time, those with water sell at a high cost that is unfavorable to us”. Respondent 3 & 4, KII.

Another key informant narrated the experience as a result of the challenges.

“Insecurity, especially among informal small-scale suppliers, has led to death. A vendor receives a call that someone has tampered with his connection. As the vendor goes to check it, they never come back alive. Also, the informal small-scale suppliers cannot pump water at night because of these threats, so they have to struggle during the day to store sufficient water for the day.”

Respondent 2, KII.

Another key informant narrated an experience as a result of water supply challenge.

“During rainy seasons, the water vendors experience pipe damages, and some are often washed by the water. As a result, the population suffers disease outbreaks such as cholera from water contamination. The last experience of cholera outbreak left at least two people dead with others experiencing infections such as amoeba and diarrhea.” Respondent 1, KII.

From the field observations, the water pipes passed through the sewage, posing the risk of water contamination by seepages. Additionally, water pipes were installed on a shallow level, reflecting the absence of institutional support in the slum informal water market. According to (Andreasen & Møller-Jensen, 2016), technical support is an important component of service provision and ensures that the supply infrastructure is able to meet the minimum public health demands. The study's findings conform to the challenges of water provision in a study conducted in Tanzania

(Mapunda et al., 2018a).

4.6 Households' Perceptions of The Informal Small-Scale Water Supply System.

The respondents acknowledged the significance of the informal water operators as discussed in the conventional literature (Bakker, 2011; Braimah et al., 2018; Mapunda et al., 2018b). 83.8% of the surveyed households perceived the operators as integral to meeting their daily water needs. A frequency of 83 (79%) of the household respondents accepted the system and strongly agreed that the informal water operators should be supported to enhance water service delivery in the settlement. Additionally, 62.9% of the household respondents strongly agreed that in the future, the informal small-scale supply system would be able to address future water needs. The respondents pointed out that the system had effectively met their daily water needs in the past, which could happen in the future. In the absence of the main utility provider, a significant proportion of the study settlements showed optimism about the system.

To affirm the respondents' perception of the informal small-scale supply system, they were asked their preferred water collection point: either collect water from the water vendors or the vendors' source. 75.2% of the household respondents preferred buying water from the water vendors, 22.9 opted to collect water from the vendors' source, whereas 1.9% mentioned "do not know" as a response. Households preferred the water vendors because of the short distance. As highlighted by a respondent, *"I prefer collecting water from the vendor because it is close to the house, unlike going so far, and I do not know how much I will be charged at the vendors' source."*

In reference to water quality, there was a thin margin in the responses. 31.4% of the household respondents perceived the water quality as very good, 31.4% perceived it as just good, 23.8% felt it was very poor, and 13.3% felt it was poor. From the respondents' perspective, *"We cannot say the water is very good because of the passage. We have pipes running through the sewage to the water standpoints. At times, the water has a bad smell, and when collected in a container, if it is transparent, you will see the particles settled in the bottom."* From a key respondent perspective, Mukuru Kwa Njenga is the home of cholera outbreaks. *"Residents in Mukuru Kwa Njenga hardly*

treat their drinking water. As a result, we have had cholera outbreaks leading to deaths.”

Respondent 4, KII. Of the 105 household respondents interviewed, just 37.1% indicated that the settlement had experienced water-related illnesses, whereas 62.9% indicated no outbreak within one year. 13.3% of the households had suffered from cholera outbreak, 8.6% suffered from typhoid fever, and 8.6% suffered from diarrhea. While water quality was a concern in the surveyed households, 74.3% of the household respondents attested to not knowing the vendors' source, whereas 25.7% indicated Nairobi water as the vendors' source.

To minimize the water-related illnesses in the settlement, the surveyed households attested to employ various water treatment methods as a form of drinking water purification; 32.4% of the respondents add chlorine, 25.7% boil their water, 1% employ the filtering method, 1% employ the settling method, and 40% do not treat their drinking water.

In relation to water pricing, households expressed concern about the vendor charges. According to the respondents, the vendor pricing was more of profit maximization than providing affordable service. 49.5% of the respondents felt that the vendor prices were too high and should be reviewed, 46.7% felt the vendor prices should stay about the same, and 3.8% indicated “do not know” as a response, stating that water was a social good and therefore should not be priced. Generally, 81% of the household respondents were satisfied with the informal small-scale supply system service delivery initiative in the settlement.

4.6.1 Summary.

In summary, the informal water operators significantly contribute to domestic water access without the formal water supply system in urban informal settlements. However, the extent to which they can effectively respond is limited by the settlement conditions, such as topographical location limiting access to major services: electricity. 17.9% of the informal small-scale operators attested to experiencing constant blackouts, 14.9% mentioned pipes bursting, 17.9 highlighted debts as a major challenge, and 10% insecurity. From the study observations, the water pipes were channeled along the sewage water to the standpipes. The shallow-level installation posed significant challenges to water consumers as constant seepages contributed to water-related illness-causing deaths and diseases in the study settlements.

Of the 105 households surveyed, 83.8% acknowledged the significance of the informal small-scale operators. 79% strongly agreed that the system be supported to enhance service delivery. Additionally, 62.9% strongly agreed that the system would still be pivotal in addressing domestic water needs in the future. This is because the system had met their past domestic water needs. The study findings on households' preferred water collection points show that 75.2% of the respondents preferred buying water from the vendors due to the distance to the vendors' source and the high billing that they would incur at the source.

The study findings on household perception of the water quality show that 31.4% perceived the water quality as very good, 31.4% as just good, 23.8% stated that the water quality was very poor, and 13.3% as just poor. From the respondents, the quality was perceived based on the odour, colour, and channeling. From the findings, just 37.1% attested to having experienced water-related illnesses due to the poor water quality. 13.3% of the household respondents had suffered from cholera outbreak, 8.6% suffered from typhoid, and 8.6% attested to have suffered from diarrhea. While water quality was a concern in the settlements studied, 74.3% of the surveyed households did not know the vendors' water source. Moreover, 40% of the households did not treat their drinking water before consumption.

Finally, the study findings on the household perception of water pricing show that 49.5% wanted the vendors' prices reviewed, and 46.7% felt the prices should stay the same. Overall, 81% of the surveyed households were satisfied with the informal small-scale supply system service delivery initiative in the settlement.

CHAPTER 5: SUMMARY, CONCLUSION AND RECOMMENDATION.

5.1 Summary.

Overall, the research study sought to examine the influence of the informal small-scale water supply system on domestic water service delivery in Mukuru Kwa Njenga, Nairobi City County. The research project comes from a background that achieving universal access to water by 2030 in SSA, requires a collective effort from both informal actors and public utility. This is because the informal actors drive the water supply in Sub-Saharan informal settlements. Therefore, it is important to assess the market operations of the suppliers and the consumers' perspectives of the informal supply market to determine the potential acceptability of alternative service provision strategies in urban informal settlements. The study areas were using the purposive sampling technique. The selected settlements include; Riara, Vietnam, and Wape Wape. The selection criteria were guided by the presence of informal water operators in the settlement. 67 informal small-scale operators, 105 randomly selected households, and 4 key informants were interviewed. The study adopted the living condition diamond framework as an argument that could influence domestic water delivery in urban slum set-up.

Empirical evidence shows that access to domestic water in urban slums is a challenge, thus leaving slum residents on the brink of water poverty. These challenges are attributed to poor governance, such as corruption, haphazard developments due to population growth, exclusions, tenure characteristics, and the spatial location of the settlements, among other factors. Therefore, the study used empirical evidence to examine the influence of informal water operators' living conditions on water service delivery in the selected urban slum areas. The tenets of the living conditions diamond framework assessed were tenure, environmental conditions, employment, household size, and water source.

The study collected quantitative data and qualitative data. Quantitative data was analyzed using descriptive and bivariate analysis, and further presented in tables and graphs. Qualitative data was transcribed and analyzed based on the thematic areas highlighted in the literature review. Descriptive analysis findings show that more males than females operated in the informal water markets. Most of these operators were between the ages of 30 to 40. They were between 3-5 people

on average in a household. Most informal small-scale operators were engaged in the water re-sale business, making an average of 400 daily. Most of the informal operators were tenants. Water was mainly obtained from NCWSC pumped through the chambers. Environmental conditions in the studied settlement affected water service delivery; more than half of the informal water operators indicated that flooding was a problem, which was affirmed by almost half of the household respondents interviewed. Descriptive results for the dependent variables show that most informal water operators always had water in the past year.

Using the Chi-square test and cross-tabulation, the study conducted a bivariate analysis to determine the correlation between the dependent variable and the predictor of water service delivery in the identified study areas. The results revealed that water service delivery did not differ across the study variables.

In reference to the challenges and household perceptions of the informal small-scale supply system, the informal water operators were found to have significantly contributed to water service delivery. However, the settlement conditions affected their levels of response. Electricity and client debts were the most significant challenges experienced by the informal water operators.

Of all the households surveyed, more than half were of the opinion that the system should be supported, acknowledging its past significance in domestic water supply in the settlement. In terms of water quality, 31.4% perceived the water as very good, which was similar to those who perceived the water quality as just good for consumption (31.4%). From the respondents' perspective, the quality was determined by the colour, odour, and channeling points to the water stand. Households were found to have suffered from typhoid, cholera, and diarrhea, which had led to the death of some residents in the studied settlements. Nevertheless, 40% of the households consumed untreated water. Additionally, 49.5% wanted the vendor prices reviewed, whereas 46.7% felt the prices should stay the same. Finally, 81% of the households were satisfied with the informal small-scale supply initiative in the studied settlements.

5.2 Conclusion.

The research study sought to determine the influence of the informal small-scale water supply system in water service delivery in Mukuru Kwa Njenga, Nairobi City County. Using the living condition diamond framework (Gulyani & Bassett, 2010), the study sought to determine the correlation between the tenets of the theoretical framework and the dependent variable in the study sample. From the study findings, males at 61.2% were found to dominate the informal water market (Braithair et al., 2018). Close relatives or the owner operated the water resale business. In the study, 85.1% of the informal water operators were fully engaged in the venture, making an average of Ksh. 400 daily. The informal operators primarily sourced their water from the state's utility, channeled through the vendors' chamber to the water points. The frequency of access depended on the different chamber locations; 38.8% of the informal water suppliers accessed water daily for 24 hours, with the least 4.5% accessing water daily for 24 hours. All the household respondents interviewed mainly sourced their water from the shared water points directly managed by the informal water suppliers, operating for about 12 hours a day, depending on water availability at the chambers. The study findings were consistent with those of (Braithair et al., 2018; Dakyaga et al., 2018; Mapunda et al., 2018b).

The settlements' environmental conditions affected service delivery. 68.7% of the informal small-scale operators reported that flooding affected domestic water delivery. The results for the tenure system show that 40.3% were house owners, and 59.7% were tenants. Given the sensitivity of land titling at the time of the study, the researcher did not ask respondents for any structure ownership documents. On water service delivery, 55.2% of the informal operators always had water, and 44.8% had access just a few days a week in the past year. However, on the correlation between service delivery and the predictors, the study findings show that service delivery did not differ with the study variables. The results for employment and household size were in agreement with the findings of (Wagala, 2020).

Lastly, the study sought to examine the household perceptions of the water operators in the slum set-up. From the study findings, 81% of the household respondents were satisfied with the informal operators' service delivery initiative in the settlement.

5.3 Recommendations.

The study findings highlight the significance of the informal small-scale water operators in urban informal settlements. In view of this, the study makes two recommendations. First, in the absence of the main utility provider, the informal small-scale water operators will continue to provide domestic water services in urban informal settlements to meet their domestic needs. In light of this, it is important to mainstream these services within the legal framework. This will entail the legal recognition of the informal small-scale operators in urban informal settlements, thus providing avenues to facilitate access to infrastructural and technical support to enhance service delivery within the settlements effectively. Also, the legal recognition of the informal small-scale water operators as an integral aspect of water service delivery can effectively facilitate effective implementation of the (WASREB, 2019).

Secondly, the state's utility, in collaboration with the government, should conduct public participation in the informal settlement to unpack the needs and perceptions of the community on water access. This will enable the community not to feel trapped in any unjust system.

In line with the observations mentioned-above, these recommendations are presented for policy makers as guidelines for effective vendor operations in slum areas.

- It is important for the state, in collaboration with the utility provider to develop water provision regulations and standards to ensure that service provision adheres to the required minimum standards in these settlements. This will ensure that the population served at these settlements are safe from water related contaminations and hygiene challenges.
- The government, in collaboration with the utility provider, should come up with appropriate infrastructure for water provision in the informal settlements. This will help the government provider water that is affordable and in a safe manner. Also, it will reduce the resident's dependent on the informal market, further providing access options for the residents.
- The government, in collaboration with the utility provider, can engage the informal operators in policy discussions that are well able to address their challenges, and effective develop strategies geared towards a win-win solution for the informal operators, the utility

and the community served.

Lastly, the study recommends conducting further research to examine the following areas.

1. Examine the role of unions/associations in shaping informal water operations (dynamics).
2. What are some of the opportunities/ challenges of incorporating the delegated management model in the studied settlements?

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APPENDICES.

Appendix 1: Survey Questionnaire for Informal Water Operators.

Introduction.

Greetings, I'm Beryl Aluoch Odhiambo, a postgraduate student in the Department of Economics and Development Studies, pursuing a master's of Development Studies at the University of Nairobi. I am conducting a research study on the influence of informal small-scale supply systems on water service delivery in Mukuru Kwa Njenga: Vietnam, Riara, and Wape Wape. The research aims to analyze the challenges experienced by small-scale water operators and the households' perceptions to identify areas for improvements and efficiency in informal domestic water supply. The collected information will be for ACADEMIC USE. All shared information will be kept confidential. Your participation will be of significance to this study. Only persons 18 years and above can participate in the survey.

1. Settlement Name.

- Vietnam
- Wape Wape
- Riara

Sample Characteristics. *(I will ask you a few questions about yourself and your household)*

2. Please tell me your name.
3. Respondents gender.
 - Male
 - Female
4. How old are you?
5. How many family members do you have?
6. Of all the family members, how many are children?
7. Of all the family members, how many are adults?
8. What is your highest level of education?
 - Primary
 - Secondary
 - College
 - No schooling

9. How about others in the family, what is the highest level of education achieved so far?

- Primary
- Secondary
- College
- University
- No schooling

10. How long has your family been occupying this house?

- Less than a year
- 1 to 2 years
- About 3 years
- More than 5 years

11. What is the type of house ownership?

- Tenant
- House owner

12. For house owners, do you feel you have a surety of the house. By secure, I mean that the state will not force you to vacate the property or evict you with an official document in which you would participate?

- Yes
- No

Employment and Household Income (*I will ask you a few questions about your household income and employment status in the past year*)

13. What has been your main activity in past year?

- Unemployed
- Selling water
- Casual employee
- Regular employee
- Self employed
- Retired/pensioner

14. On average, how many days do you work in a week?

- Five days
- Six days

- Seven days
- Four days
- Three days
- Two days
- A day
- Unemployed.

15. On average, what was your total cash income (Ksh) in the past year?

- Less than 3,000
- 3001 to 6000
- 6001 to 9000
- 9001 to 13000
- 13001 to 18000
- 18001 to 22000
- Above 22000 (specify)
- Unemployed

Water Access Data (*I will ask you about the different strategies you have used in the past year to access domestic water for daily consumption and supply to neighbors*).

16. What is the major source of water for your household?

- Indoor tap
- Shared waterpoint
- Water kiosk
- Other (specify)

17. On average, how many households do you supply with water?.....

18. How frequently do you access the supply water?

- A few days a week
- Always had water

19. How many hours of supply do you receive water from the main source when pumped?

- 24 hours

- 12 hours
 - Less than 12 hours
20. How many days can your water storage last when there is no supply?
21. How many water stands do you have?
22. Are there houses with in-house connections?
- Yes
 - No
23. Apart from households, do you supply water to any other place?
- Yes
 - No
- b). If yes, kindly specify.....
24. Who directly manages your water supply source?
- NCWSC
 - Other (specify)
25. On average, how much do you pay for water on a monthly basis?.....
26. On normal days, how many hours of supply is the water available at the stand?.....
27. In dry seasons, how many hours per day is the water available at the stand?.....
28. How much (Ksh) do you charge for a 20l jerrycan in dry seasons?.....
29. On normal seasons, how much is a 20l jerrycan (Ksh)?.....
30. How would you characterize the quality of water from the supply source?
- Very good
 - Good
 - Poor
 - Very poor
31. How would you characterize the quality of water from the water points?
- Very good
 - Good
 - Poor
 - Very poor
32. How easy/ difficult is it to install pipes within the settlement?

- Difficult process
- Easy process
- not at all easy
- not at all difficult

33. Does flooding affect water service delivery within the settlement?

- Yes
- No

34. Over the past year, has there been occurrences of water-related illnesses in your neighborhood?

- Yes
- No

b) If yes, kindly specify.....

Challenges of water provision (*I will ask you about the challenges you face when providing water to other households within the settlement*).

35. What is the most significant challenge when supplying water to consumers?.....

36. In your opinion, do you think you have enhanced water access within the settlement?

- Yes
- No

37. Is there anything else that we have not discussed and you would like to tell me about?.....

Appendix 2: Household Survey Questionnaire.

Introduction.

Greetings, I'm Beryl Aluoch Odhiambo, a postgraduate student in the Department of Economics and Development Studies, pursuing a master's of Development Studies at the University of Nairobi. I am conducting a research study on the influence of informal small-scale supply systems on water service delivery in Mukuru Kwa Njenga: Vietnam, Riara, and Wape Wape. The research aims to analyze the challenges experienced by small-scale water operators and the households' perceptions to identify areas for improvements and efficiency in informal domestic water supply. The collected information will be for ACADEMIC USE. All shared information will be kept confidential. Your participation will be of significance to this study. Only persons 18 years and above can participate in the survey.

1. Settlement Name.

- Vietnam
- Wape Wape
- Riara

Sample Characteristics. (*I will ask you a few questions about yourself and your household*)

3. Please tell me your name.....

4. Respondents gender.

- Male
- Female

5. How old are you?

6. How many family members do you have?

7. Of all the family members, how many are children?

8. Of all the family members, how many are adults?

9. Please tell me your highest education level?

- Primary
- Secondary
- College
- No schooling

10. How about others in the family, please tell me their highest education level achieved so

far?

- Primary
- Secondary
- College
- University
- No schooling

11. For how long has your family lived in this house?

- Less than a year
- 1 to 2 years
- About 3 years
- More than 5 years

12. What is the type of house ownership?

- Tenant
- House owner

13. For house owners, do you feel you have a surety of the house. By secure, I mean that the state will not force you to vacate the property or evict you with an official document in which you would participate?

- Yes
- No

Employment and Household Income (*I will ask you a few questions about your household income and employment status in the past year*)

14. What has been your main activity in past year?

- Unemployed
- Casual employee
- Regular employee
- Self employed
- Retired/pensioner

15. On average, how many days do you work in a week?

- Five days
- Six days
- Seven days

- Four days
- Three days
- Two days
- A day
- Unemployed.

16. What was your average monthly income (Ksh) in the past year?

- Less than 3,000
- 3001 to 6000
- 6001 to 9000
- 9001 to 13000
- 13001 to 18000
- 18001 to 22000
- Above 22000 (specify)
- Unemployed

Water Access Data (*I will ask you about the different approaches you have used over the last 12 months to obtain water for your daily consumption*).

17. What is your primary water source?

- In-house private connection
- Shared water point
- Water kiosk
- Other (specify)

18. Who is directly managing the water supply?

- CDF
- Community
- Private
- Fresh life
- Municipality
- N.G.O
- Ward Development
- Government.

19. Besides your household, do your neighbors obtain water from the same?
- Yes
 - No
20. How would you define the quality of water your main source of water supply?
- Very good
 - Good
 - Poor
 - Very poor
21. On normal seasons, how much do you pay for a 20l jerrycan (Ksh)?.....
22. In dry seasons, how much do you pay for a 20l jerrycan (Ksh)?.....
23. How many litres does your household consume daily: washing, cooking, personal hygiene, and drinking?
24. How frequently do you fetch water?
- Daily
 - Once a week
 - Twice a week
 - Thrice a week
 - Other (specify)
25. Beside your main water source, do you obtain water from other sources?
- Yes
 - No
- b) kindly name the source.....
- c) How many minutes/hrs does it take you to collect water from other water source?
- Less than 30 minutes
 - 30 minutes to 1 hour
 - 1 hour to 2 hours
 - More than 2 hours.
26. For each water trip, on average, how long does it take you (in minutes) to travel to and from your main source of supply, including waiting and filling the container?
- Less than 15 minutes
 - 16 to 30 minutes

- 31 minutes to 1 hour
 - 1 to 2 hours
 - More than 2 hours
27. How many hours per day is the water available on normal days?
28. How many hours per day is the water available on normal days?
29. Do you treat your drinking water?
- Yes
 - No
30. If yes, what method or technique do you apply?
- Boiling
 - Adding chlorine to water
 - Filtering
 - Letting it settle
 - Sieving through a cloth
 - Does not treat.
31. Has there been occurrence of water-related illnesses in the last 12 months?
- Yes
 - No
- b) If yes, which one.....

Household perception towards informal small-scale water operators (*I will ask your opinion about the water operators and how they are meeting your daily water needs*).

32. In your opinion, do you agree with the statement: Informal water service providers are significant in meeting my daily water needs.
- Strongly agree
 - Agree
 - Somewhat agree
 - Strongly disagree
 - Disagree
 - Refused to answer
33. In your opinion, do you agree that the system should be supported to enhance water provision in the settlement.

- Strongly agree
 - Agree
 - Somewhat agree
 - Strongly disagree
 - Disagree
 - Refused to answer
34. Do you think they will be able to address your water needs in future?
- Strongly agree
 - Agree
 - Somewhat agree
 - Strongly disagree
 - Disagree
 - Refused to answer.
35. Given an opportunity to choose, would you prefer to buy water from the vendors or collect it from the vendors' source?
- Prefer collecting at the source
 - Buy from vendor
 - Don't know
 - Refused to answer
36. In your opinion, what do you think is the main challenge affecting water vendors?.....
37. In your opinion, where do you think the water vendors obtain their supply water from?
- NCWSC
 - Boreholes
 - Other (specify)
 - Don't know
38. In your opinion, do you think the vendor prices should be reviewed or stay about the same?
- Should be reviewed
 - Stay about the same
 - Don't know
39. Overall, are you satisfied with the vendor initiative of water supply in the settlement?
- Satisfied

- Not at all satisfied

40. Is there anything else that we have not discussed and you would like to tell me about?

Appendix 3: Key Informant Guide.

- 1) In literature, informal small-scale water operators are considered to play a significant role in water service delivery in urban informal settlements. What are your views on the same?
- 2) What is the model of operation?
- 3) Are there requirements; for instance, are they restricted on the number of households to supply water to?
- 4) Where do you think they source their water from?
- 5) For how long has the service provider supplied water to the informal operators in the settlement?
- 6) How many hours is the water available?
- 7) Are there days when there are interruptions? Are the interruptions communicated to consumers?
- 8) In case of these interruptions, where do consumers obtain water from?
- 9) For each water trip, on average, how long does it take consumers (in minutes) to travel to and from other source of supply, including waiting and filling the container?
- 10) In your opinion, how would you perceive the quality of water from the stand points? How about the quality of water obtained by consumers from other supply source?
- 11) How often is the water from the standpipes tested?
- 12) What is the cost of a 20l jerrycan during dry and normal seasons?
- 13) In your opinion, do you think the water supplied by the vendors is affordable?
- 14) In the past year, has there been occurrence of water-related diseases?
- 15) How can the services provided by the informal small-scale operators be made more efficient?
- 16) Are there challenges that you think the informal small-scale operators face while supplying water to consumers?
- 17) Overall, would you say you are satisfied with the vendors initiative of water provision in the settlement?