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Can Informal Water Vendors be Trusted? The Evolution of Informality in Kisumu's Delegated Management Model

GINA GRACE GILSON^{*,#}, DUSTIN GARRICK^{*,**},
ONYANGO CERSEY OCHIENG[†], ELISHA OCHIENG OKOTH^{**} &
GEORGE MORARA OGENDI[†]

^{*}School of Geography and the Environment, University of Oxford, Oxford, United Kingdom, ^{**}School of Environment, Resources and Sustainability, University of Waterloo, Waterloo, Canada, [†]Department of Environmental Science, Egerton University, Nakuru, Kenya

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ABSTRACT *In the world's lower income regions, piped water systems have failed to keep pace with growing populations. A wide variety of informal water vendors are playing an important role in filling these gaps, which are projected to grow as the urban population increases to 2.5 billion by 2050. Though informal water vendors provide essential services that can be agile and locally managed, vending comes with potential risks, including those related to affordability and poor water quality. This has lead scholars and practitioners alike to ask: under what conditions can water vendors be trusted? We unpack this question in Kisumu, Kenya, where consumers are served by a diversity of actors that may work with or independently of the utility. We ask how coordination between the utility and informal water vendors affects the performance of co-produced water services, investigating performance in terms of trust and trustworthiness. Our results show that partnerships with informal providers offer opportunities to leverage social trust and relationships, bolstering the capacity of institutions to deliver on their objectives of safe, affordable water. These insights are important in ensuring the human right to water as rapidly growing cities rely on a patchwork of piped and off-grid water supplies.*

KEYWORDS: Informality; trust; decentralisation; water vending; East Africa; delegated management model

1. Introduction

Rapid urbanisation and infrastructure inequalities are creating conditions of plumbing poverty, where piped water systems either fail to keep pace or deliver unreliable or poor quality water

Correspondence Address: Gina Grace Gilson, South Parks Rd, Oxford OX1 3QY, United Kingdom. Email: gina.gilson@gtc.ox.ac.uk

[#]Additional affiliation: Udall Center for Studies in Public Policy, University of Arizona, Tucson, Arizona, USA.

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(Meehan, Jurjevich, Griswold, Chun, & Sherrill, 2021). This gap already affects approximately 4.4 billion people worldwide who have inadequate access to safe drinking water at home (Greenwood et al., 2024), and is expected to worsen as nearly 2.5 billion more people will live in cities by 2050 (United Nations Department of Economic & Social Affairs Population Division, 2018). Over 80% of new urban residents will be living in the world's low and middle-income countries, where piped water availability can be unreliable or non-existent (Vedachalam et al., 2017). In response, new models of modular, adaptive, and decentralised (MAD) water infrastructures are emerging with novel technologies, institutions, and practices to produce, transport, and store clean water (Stoler et al., 2022; Wutich et al., 2023). Among these are informal water vendors, a term which we use to refer to sellers of water whose operations are independent, small-scale, and unregulated.

The 'informal economy' traditionally refers to business activities which are unregistered and unregulated (Bruton, Ireland, & Ketchen, 2012; Galdino, Kiggundu, Jones, & Ro, 2018). Contrary to expectations that the informal economy would shrink with continued development (Emmerji, 1991), it has continually expanded and now makes up for over 85% of employment in Sub-Saharan Africa (International Labor Office, 2018). The divide between the formal and informal is blurred in the water sector, where some vendors function as an extension of the utility network and others operate outside of existing infrastructures, either in absence of regulation (informal) or in defiance of it (illegal) (Ranganathan, 2018).

A growing body of research has adopted a classification of water vendors based on the source type and method of delivery (Kariuki & Schwartz, 2005; Raina, Zhao, Wu, Kunwar, & Whittington, 2019; Whittington, Lauria, Okun, & Mu, 1989). Their distribution methods may be stationary, networked, or mobile. Mobile delivery may include bulk delivery via tanker trucks, but in many low-income settings it is bottled or bagged and delivered manually (Stoler, 2017; Vedachalam et al., 2017). At the turn of the century, studies estimated that over 75% of the urban poor relied on vending across 10 African cities (Collignon & Vézina, 2000), and reliance on vending remains high in cities across lower-income regions—though the illegibility of vendors makes their contributions hard to trace (Garrick, O'Donnell, Moore, Brozovic, & Iseman, 2019; O'Donnell & Garrick, 2019). Informal water vendors have been considered 'unimproved' water sources due to a lack of data on accessibility, availability, and quality, but growing evidence has pointed to their potential role in delivering safe water (World Health Organization, 2017).

The prevalence of water vending has given rise to an era of institutional hybridity linking the formal and informal, where vendors act as co-producers of water service delivery (Faldi, Rosati, Moretto, & Teller, 2019; Mitlin, 2018; Mitlin & Bartlett, 2018). Given the heavy reliance on water vending globally, there is a need for better empirical evidence to understand how it works in different contexts in order to address inequities in water provision, sustainability, and governance (Wutich et al., 2023). As partnerships grow increasingly popular between the utility and different types of community actors (Adams, Sambu, & Smiley, 2019), 'we need to learn more about how the utility and informal providers compete and cooperate with one another' (Munro & Kweka, 2021, p. 10). In this context, there are important questions about the design of coordination mechanisms, such as partnerships or unionisation, and their capacity to improve performance (Cairncross & Kinnear, 1991; Njiru, 2004; Sansom, 2006; Wutich, Beresford, & Carvajal, 2016).

Literature on water vending has examined whether informal water markets are competitive (i.e. whether vendors have power to control prices) and the implications for distributive justice, or the affordability and quality of water delivered (Raina et al., 2019; Wutich et al., 2016). Early studies documented that the cost of vended water could be from 4 to 60 times higher than utility water, raising questions about whether vendors have market power that allows them to extort consumers (Bayliss & Tukai, 2011; Collignon & Vézina, 2000; Whittington, Lauria, & Mu, 1991). Studies have raised concerns that cartels may manipulate the market (Boakye-Ansah, Schwartz, & Zwarteveen, 2019; Sarkar, 2020), while others have found that costs reflect

labour-intensive inputs along the supply chain, with vendors making modest profits (Kariuki & Schwartz, 2005; Kjellén, 2000; Klassert et al., 2023; Raina, Gurung, & Suwal, 2020; Whittington et al., 1989).

Cost comparisons are fraught for several reasons, particularly the difficulties of attributing differences in prices to profit motive alone. Vendors face much higher operating costs per unit of water, while piped water networks typically rely on subsidies for public water systems (O'Donnell & Garrick, 2019). They also inadequately consider the reasons why areas are not piped in the first place—often related to topography, source capacity, cost recovery challenges, and insecure land tenure. In these cases, informal water vendors may offer better availability or quality of water where public infrastructure for treatment and delivery is lacking (Zozmann, Morgan, Klassert, Klauer, & Gawel, 2022), or provide flexible payment and credit systems that are better suited to the budget cycle of low-income households, especially when large down payments for connections are an obstacle (Hailu, Smith, & Tsukada, 2011).

Uncertainty remains about whether, how, and why water quality changes along informal water supply chains. Research has documented the deterioration of quality when transported by tanker truck—such as in Nsukka, Nigeria, where researchers found an 8.7% reduction in terms of compliance with WHO drinking water standards (Nnaji, Eluwa, & Nwoji, 2013). For consumers who rely on water vendors, concern about water quality is a cause of emotional distress (Kangmennaang, Bisung, & Elliott, 2020) as vendors may not be honest about their source and consumers have limited tools for verification (Mapunda, Chen, & Yu, 2018). However, issues of contamination are not straightforward, as vendors may be transporting water that is already contaminated at the tap (Ayalew et al., 2014), and household water storage practices may contribute to contamination (Nnaji, Nnaji, & Ekwule, 2019). Growing research points to the complexity of quality issues, as even piped drinking water sources may be affected by faecal contamination (Greenwood et al., 2024).

Many governments have ignored informal water vendors, often because of the incompatible ways in which the formal and informal water sectors operate (Sansom, 2006). In such cases, vendors may 'organise themselves to safeguard distributive justice by ensuring that the water they deliver is safe and affordable' (Wutich et al., 2016, p. 23). Associations may function to protect vendors by creating a support network in the absence of formal employment benefits (Cain & Baptista, 2020), or establish solidarity among migrant workers where water vending is considered a shameful profession (Youngstedt, Keough, & Idrissa, 2016). But in other cases, cooperation among vendors may involve cartels, where powerful local actors exert control by leveraging historically-fraught social relations (Boakye-Ansah et al., 2019; Ahlers, Güida, Rusca, & Schwartz, 2013; Sarkar, 2020). Though governments are increasingly acknowledging vendors' potential role and taking steps to embrace their contributions, formalising vendors requires a high level of capacity. Instead, there are many intermediate coordination mechanisms that vary in degree of capacity required (Gilson & Garrick, 2025), such as when utilities use bulk rates that facilitate the delivery of safe water via tanker truck (Sansom, 2006). In light of these options, researchers have called for further work on how coordination mechanisms between the formal and informal sectors might enable social accountability (Nansubuga, Smith, & Jeffrey, 2022).

In this research paper, our overarching question is: how does coordination between the utility and informal water vendors affect the performance of co-produced water services? To answer this, we analyse the water vending network in Kisumu, Kenya, where there are a variety of arrangements that may be formal, informal, or hybrid. First, we pair interview data with a literature review to explore how formal and informal rules have evolved to govern new institutional arrangements, and how rule configurations impact trust and trustworthiness. Second, we investigate present-day performance in terms of trust, which allows us to assess both trustworthiness of water service delivery outcomes while also including perceptions of equity and justice among consumers, utility staff, and vendors.

2. Background

2.1. Rules and institutional trust in the informal water sector

Though informality is conceptualised in opposition to formality, scholars are attempting to better understand informality by moving beyond a simple binary that is based on Western, Euro-centric ideals as the endpoint for formalization (Dungy & Ndofor, 2019; Galdino et al., 2018; Gómez-Cruz, Anzola, & Batz Liñeiro, 2024). In doing so, institutional theorists focus on informal institutions as a set of unwritten rules, described as norms and rules-in-use, which manifest in culture and social networks (North, 1990). Especially in developing countries, informal institutions are thought to play a large role, both in shaping informal economies (Williams, Horodnic, & Windebank, 2015) and mediating relationships between formal and informal institutions (Casson, Della Giusta, & Kambhampati, 2010). We draw on the work of Ostrom (2005), who broadly defines institutions as ‘the prescriptions that humans use to organise all forms of repetitive and structured interactions including those within families, neighbourhoods, markets, firms ... and governments at all scales’ (Ostrom, 2005, p. 3). This literature differentiates between written *de jure* rules (e.g., government policies) and *de facto* rules-in-use that structure governance in practice on the ground. Instead of a binary, scholars in this tradition propose focusing on a continuum of formal intervention in different economic activities (Guha-Khasnobis, Kanbur, & Ostrom, 2006).

We investigated three main rule classes to understand the interplay between formal and informal water systems: boundary rules, choice rules, and information rules (Crawford & Ostrom, 1995). First, boundary rules— frequently called entry and exit rules— define who is eligible to enter a position, the process by which eligible actors may (or must) enter positions, and how an individual may (or must) leave a position. This provides insights into who can become a vendor and what is required for each vendor type. Second, choice rules define required, permitted, or forbidden actions to an individual in a particular position. This provides insight into the coordination between vendors and the ways in which they are organised, particularly choices vendors make about which consumers to serve and how prices are set, and whether they coordinate with other vendors in this process. Finally, information rules determine how information flows among actors by obligating, permitting, or prohibiting actors from communicating with one another, and stipulating the language, form, and frequency of communication. Information rules are important to understand the intersections between the formal and informal sector, as well as communication between actors in the supply chain.

2.2. Understanding performance through trust

Amidst growing interest in informal water vending, explicit attention to trust in informal water systems has been less common (but see Munro & Kweka, 2021). When explored at the interface of formal and informal water systems, trust can help us to understand how a system is serving diverse populations among broader socio-political dynamics (Wilson et al., 2023). Diverse forms of cooperation among private and public water providers make trust both important and challenging, particularly as the boundaries of formal systems expand to encompass services such as kiosks and tankers that previously operated independently from utilities. While the performance of diverse water vendors has often been assessed in water-related metrics such as access, price, quality, and reliability (Gawel & Bretschneider, 2017), Wilson et al. (2023) problematise that trust is further linked to a belief or expectation that officials and institutions will act in the interests of justice.

In the literature, trust in institutions is studied according to two main approaches: institutional performance and social trust (Kaasa & Andriani, 2022). Institutional performance approaches stipulate that trust will thrive ‘when public institutions are successful in delivering the goods and services they were designed to’ (Godefroidt, Langer, & Meuleman, 2017, p. 908).

However, trust cannot be measured in performance metrics alone, but must instead be based on an individual's evaluations of institutional performance (Berg & Hjerm, 2010). Social trust approaches hypothesise that trust originates in 'long-standing and deeply seeded beliefs about people that are rooted in cultural norms' (Mishler & Rose, 2001, p. 31). Social trust approach sees institutional trust as an extension of the trust individuals have towards others (Godefroidt et al., 2017), incorporating procedural aspects of trust such as helpfulness, as well as relational aspects of fairness or corruption (Kaasa & Andriani, 2022). We draw on both institutional and social trust approaches to examine various water vending supply chain, with the aim of better understanding outcomes for consumers and the perceived trustworthiness of different arrangements.

2.3. Research setting

Kenya has a long history of informal water vending (Thompson et al., 2000; White, Bradley, & White, 1972) and has been recognised for their efforts to incorporate the informal sector in water service delivery (Castro & Morel, 2008). Building on national decentralisation efforts and the National Water Act of 2016, the Kenyan government has established pathways to recognise and incorporate diverse small-scale providers—most recently illustrated by the Water Vending Guidelines, which provide clear pathways for water providers to flexibly work with informal vendors (WASREB, 2019). We focus on Kisumu, Kenya's third-largest city, where the local utility was an early adopter of hybrid approaches to water service delivery through the Delegated Management Model (DMM).

Kisumu Water and Sanitation Company (KIWASCO), which began its operations in 2003, is mandated to provide the city's drinking water and sewerage disposal. The DMM was implemented in 2004 to create partnerships between the water utility and informal water operators. In the DMM, the utility establishes contracts with master operators (MOs), who are then responsible for water distribution. Though the relationship with the MOs has been formalised, what happens between the MOs and the consumers falls outside of the formal system. This innovation attracted attention from researchers and development practitioners, resulting in a series of studies regarding how the DMM has been designed, how it has been working, and for whom (Ayalew et al., 2014; Boakye-Ansah et al., 2019; Dery & Bisung, 2022; Munala & Kainz, 2012; Nganyanyuka, Martinez, Wesselink, Lungo, & Georgiadou, 2014; Okotto, Okotto-Okotto, Price, Pedley, & Wright, 2015; Sarkar, 2020; Schwartz & Sanga, 2010; Sima et al., 2013). This multi-disciplinary and longitudinal perspective reveals a nuanced picture of successes and setbacks, making Kisumu an ideal place to better understand how coordination with informal providers may affect the dynamics of trust over time.

As of the latest census, Kisumu city has 397,957 inhabitants in the urban centre (Kenya National Bureau of Statistics, 2019). The highest population densities are in the city's informal settlements, and the population of the city is expected to double in the next twenty years (County Government of Kisumu, 2020). To meet demand, KIWASCO relies on two primary sources of water: Lake Victoria (Dunga Treatment Facility), and the River Kibos (Kajulu Water Works). Though the water from Lake Victoria is plentiful, it is contaminated by agricultural and industrial practices and is relatively energy-intensive due to the required uphill pumping. In contrast, the River Kibos is less polluted and requires less energy consumption, but is unreliable due to seasonal low flow yield.

According to their 2022 annual report, KIWASCO covers 91% of the city—calculated as the number of people served with potable water as a percentage of the total population (KIWASCO, 2022). However, the utility notes that its pro-poor department has struggled to keep pace with the growth in peri-urban parts of the city, citing inadequate supply in low-income areas (KIWASCO, 2021). KIWASCO also continues to struggle with non-revenue water (NRW), which was at 31% in 2021 and attributed to aging infrastructure, damages from

ongoing construction works, illegal bypasses, meter thefts, and vandalism (KIWASCO, 2022). These challenges mirror concerns and constraints faced by growing cities that lack infrastructure finance and institutional capacity, making Kisumu an important setting to advance theory and generate practical insights.

3. Research methods

3.1. Data collection

Fieldwork began with a four-month period from February through May 2022, where the lead author established relationships with local partners, refined the design of the project, and obtained local approvals and permits. Data collection instruments and protocols were subject to ethical review at the lead author's institution (Oxford Central University Research Ethics Committee Approval Reference: SOGE1A2021-044) and the Kenyan partner institution (Egerton University Ethics Approval Reference: EUREC/APP/175/2022). A research permit was acquired through Kenya's National Commission for Science and Technology (NACOSTI Permit: NACOSTI/P/22/22775). Primary data was collected in January and February of 2023. We chose to do fieldwork during the dry season because we expected to see more vendors during this time based on seasonal variability documented in previous studies and in conversations during the scoping phase of research (Raina et al., 2020; Whittington et al., 1989).

To answer our research question, we chose study sites based on the prevalence of water vending in two categories: those working directly with KIWASCO at the interface of formal and informal, and private vendors (e.g. tankers, handcarts) operating more informally. For the former, we began with a list of DMM operators provided to us by the utility. For the latter, the literature suggests that water vending is likely to be prevalent in areas with low piped water coverage, particularly in low-income areas and on the growing edges of the city with limited formal infrastructure. We combined these insights with key informant interviews, who confirmed that tanker trucks fill at the Dunga Treatment Facility, operated by KIWASCO. Our geographic focus included the urban centre (CBD), the urban informal settlements of Nyalenda, Manyatta, and Nyamasaria, and the peri-urban area of Bouye (see Figure 1).

We used purposive sampling techniques to identify our key informants (Cresswell & Plano Clark, 2011), and chain referral snowball sampling to access multiple networks that more closely resembled the study group (Penrod, Preston, Cain, & Starks, 2003). We began semi-structured interviews with key informants involved in water service provision, such as the Kenyan Water Services Regulatory Board (WASREB), KIWASCO, and individuals working in government, development agencies, and non-profit organisations. As shown in Table 1, we conducted interviews along the water vending supply chain, including at the source (the utility), with intermediaries (kiosks, tankers, handcarts), and users (households and small businesses). All interviews followed a structured interview guide addressing the history of the DMM, coordination with informal providers, urbanisation dynamics, and trust.

Our purposive snowball sampling along the supply chain began with KIWASCO's list of 17 Master Operators (MOs) in the DMM. The MOs would refer us to areas where we could locate household clients as well as water points where handcart vendors fill their containers. The researchers then visited these locations and randomly selected vendors and households in two ways: first, when containers were filled at kiosks and household water points, and second, when water delivery was observed. Key informant interviews were conducted in English, while interviews with vendors along the water vending supply chain were conducted in the local Luo language and then transcribed by a trained research assistant who is fluent in English, Luo, and Swahili.

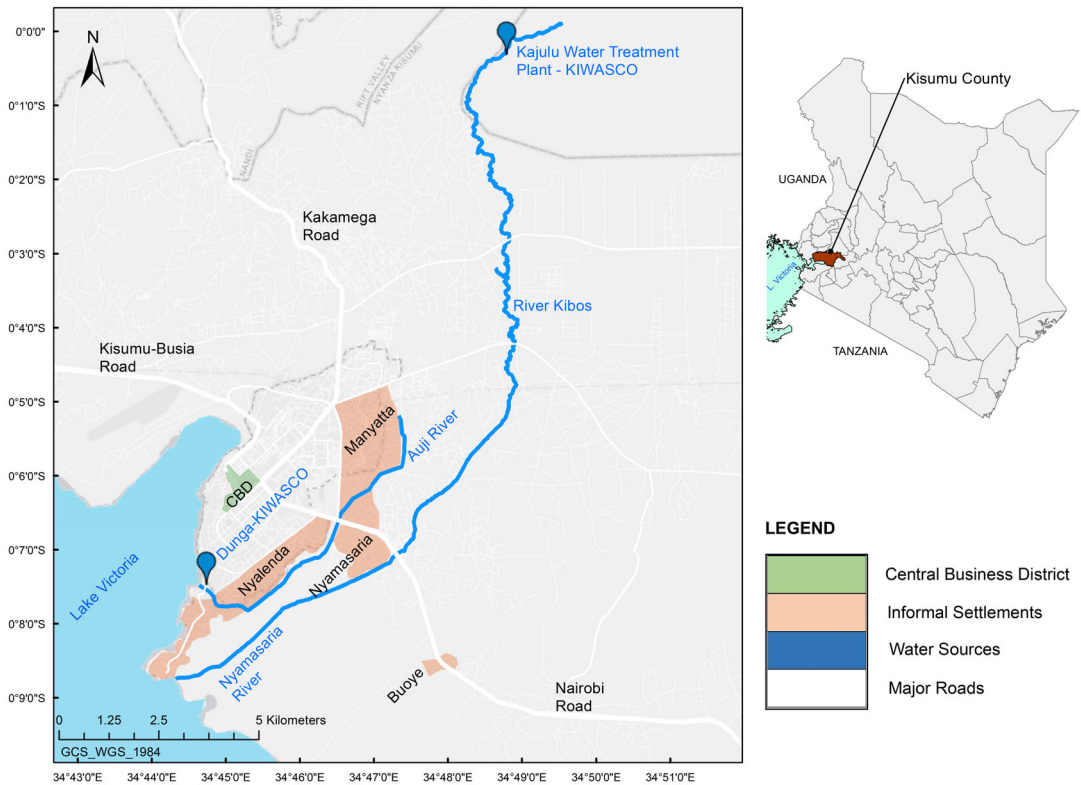


Figure 1. Study area in Kisumu, Kenya. The municipal boundary for Kisumu is marked by the dotted line, with main water sources are depicted by blue circles. The informal settlements were digitized using the spatial layer in UN Habitat, 2020, pg. 4 (Figure 2, ‘Informal settlement areas and survey data points’), where informal settlements were based on the interpretation of images and ground-truthed through local knowledge. The map was digitized using ArcMap 10 software by converting this map to JPG format, importing and georeferencing the JPG map, creating a new shapefile, and digitizing the informal settlements by using the ‘Create Features’ and ‘Editor’ tools.

Table 1. Interview list

Interview list			
Interview code	Type	Entity	Number
Key Informant (KI)	Water Sector	Regulator	2
		Utility	4
		Water resources authority	1
		Private sector	1
	Local govt	County	2
		City	2
	Other	Non-profit	5
		Academic/research	2
		Development agency	1
Consumers (C)	Consumers	Business	5
		Household	24
Vendors (V)	Vendors	Handcart	14
		Tanker truck driver	4
		MO	8
		Household resale	3
		Kiosk	1
Total number of interviews			79

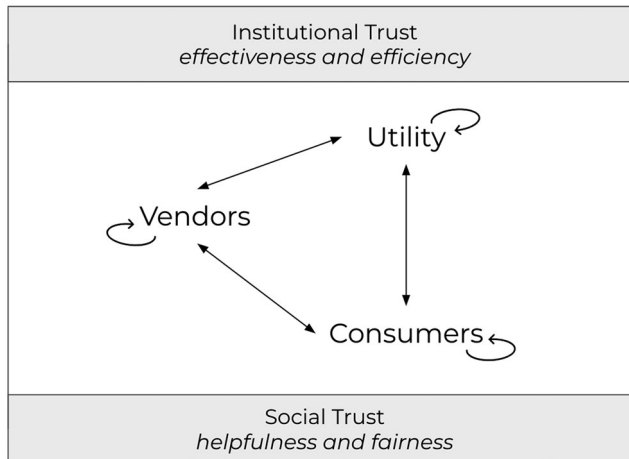


Figure 2. Framework for measuring trust. Lines capture trust between groups, while loops capture trust within groups.

3.2. Data analysis

Our institutional analysis was organised across three categories of rules: boundary rules, choice rules, and information rules. In each of these categories we paired a review of the literature with interviews to classify how rules-in-use have evolved. We also assessed two dimensions of trust (Figure 2) according to our theoretical framework, measuring perceptions of institutional performance (i.e. whether water was available, considered safe, and affordable) and social trust (perceptions of procedural aspects and interpersonal aspects).

Our questions incorporate the methodological choices made by Munro and Kweka (2021), whereby participants were asked to what extent they think an actor is trustworthy, with response options of: i) not at all, ii) not much, iii) to some extent, and iv) all the time. This framing included conceptual components of trust described in our framework, and allowed respondents to express optimism by choosing positive answers. However, where Munro and Kweka (2021) conducted quantitative surveys, we adapted their methods for qualitative interviews where we asked interview participants to elaborate on their answers. This is because we focused on qualitative insights about trust dynamics amidst a smaller sample of consumers, vendors, and the utility. Our sampling strategy captures the diversity of actors and the interactions among and within different groups, but it is not representative or generalizable at the ward or city levels. Therefore, the study results offer suggestive evidence about trust within and across groups to support the development of hypotheses and guide future research. Further, as our study focused on how informal water vendors might contribute to SDG 6.1 of universal and equitable access to safe and affordable drinking water for all, we limited our consumer interviews to household consumers and a few small business owners while excluding large institutional consumers such as schools, health care facilities, or religious organizations. Our consumer data captures experiences of households depending on water vendors selling smaller quantities (e.g. kiosks, handcarts, household resale).

4. Results

4.1. The evolution of the DMM

When Kisumu was designated as a city in 1996, much of the urban population growth was in informal settlements. The costs of direct connections were too high for many low-income residents, and high rates of non-payment created challenges for the utility's cost recovery. To fill

unmet demand, 'water cartels' were active in Kisumu, defined as water actors who would create illegal connections to utility pipes and distribute the water. These vendors charged rates that were considered unaffordable by many poor households, with anecdotal evidence that they would sometimes fabricate shortages to raise prices, leading residents to rely on shallow wells and other free or cheap sources which were often untreated and contributed to waterborne illnesses. Though these challenges were not unique to Kisumu, the coincidence of a supportive regulatory environment, utility willingness, and donor interest created an opportunity for the implementation of a new partnership model (Butcher, 2016).

The DMM was first implemented in 2004 in Kisumu's Nyalenda A neighbourhood (Schwartz & Sanga, 2010). Under the DMM, the formal utility entered into contracts with five small-scale providers called Master Operators (MOs), who were to supply water and oversee piped connections in their designated area (Nzengya, 2015; Schwartz & Sanga, 2010). This introduced significant institutional changes to service provision, creating opportunities for building social trust between the utility and the new actors, who were all drawn from the informal settlements (Nzengya, 2018). Key informants described the DMM as 'using a thief to catch a thief' (KI07, KI10) as the utility partnered with those who had been making illegal connections, who were better positioned to monitor for pipe bursts, resolve conflicts, and prevent vandalism. *'The thieves within this informal settlement were given the responsibility of now managing the DMM— so these people are very much familiar with the networks within the informal areas ... they knew very well those who were stealing water ... and [could] manage issues of non-revenue water'* (KI10).

The utility attempted to build institutional trust within the DMM based on improved design, performance, and outputs. They provided technical support for the MOs, and the 2-year contracts between MOs and the utility led to more uniform pricing and hygiene standards. For consumers, the DMM helped to lower the cost of water (Nzengya, 2018), and rates of water-related diseases dropped significantly. For the utility, the DMM helped to decrease Kisumu's non-revenue water from 70% to 7% (Boakye-Ansah et al., 2019; Nzengya, 2018; Schwartz & Sanga, 2010).

Though boundary rules to become an MO included strict eligibility criteria related to financial stability and educational background, researchers documented that those with financial means and existing connections were the most well-positioned to get these roles (Boakye-Ansah et al., 2019). The DMM also included new choice rules to ensure that the MOs were accountable to both the utility and their consumers, including rules related to price setting, hygiene, and cost recovery. An MO serving their own community could be in the awkward position of collecting payments from their struggling neighbours, creating tension between adhering to social norms within their community versus complying with contracts. One vendor shared, *'how do I disconnect water to a fellow community member, an old mother, who I know very well will sleep hungry with all her kids when I do so?'* (V013).

As the DMM matured, physical access to water improved throughout the city, but persistent gaps meant that residents still relied on alternative water sources such as wells, boreholes, private treatment facilities, and distributing vendors such as handcarts (Ayalew et al., 2014; Owuor & Foeken, 2012; Sima et al., 2013). In 2013, between 81–93% of kiosk customers interviewed across three informal settlements said that water was unreliable, with the lowest percentage in Nyalenda A (81% of 109 customers) (Nzengya, 2018). Similar challenges were observed in 2019, when residents of Nyalenda A, Nyalenda B, and Obunga informal settlements complained of pipes not being fixed quickly, poor complaint response procedures, and confusion about responsibilities where the water service providers were performing below expectation (Otieno & Chege, 2021). Private and non-profit actors played an emerging role in providing other water sources, such as kiosks owned by the Safe Water and Aids Project (SWAP), which sell treated water to mobile vendors at preferential rates (KI14). As the growing middle-class were able to drill their own boreholes, they also began to see the business opportunity of selling water, especially via tanker truck (KI16).

In terms of information rules, technological advances have improved communication with consumers, who are increasingly aware of their rights. Interviewees described how community monitoring improved as residents used social media groups to seek support in instances of injustices or irregularities, leading to court cases for collusion and price hikes. New relationships were key in resolving conflicts in a way that the utility could not have done otherwise due to a history of distrust between low-income residents and government actors. As a key informant described, *‘Within the slum areas, the government is always an enemy... so if you are from the county, if you are KIWASCO, if you are the city, we interact with you very suspiciously’* (KI15). This distrust still creates problems when MOs lose their licenses due to fund mismanagement, where utility staff take over operations, they may be met with hostility, vandalism, or sabotage. This occurred for multiple MOs in Nyamasaria in 2022, and was similarly documented in 2017 for three MOs in Nyawita (Boakye-Ansah et al., 2019).

The new management structure initially failed to create opportunities for women to serve as MOs (Munala & Kainz, 2012), prompting the DMM to encourage women and women’s groups to get involved in water service provision as MOs (Nzengya, 2015). However, multiple women-run MOs have been shut down due to issues of financial mismanagement, as young women move away, and older women lack the skills to maintain the business. At the household level, water remains a gendered issue and male consumers would frequently decline interviews, sometimes becoming agitated when asked about household water practices. For women consumers, interviews and surveys suggested that women may be exploited for sexual favours—a phenomenon that has been documented elsewhere in Kenya (Kewasnet & Anew, 2020).

4.2. Rules guiding water vending supply chains

At the time of our study, there were 17 MOs operating within Kisumu, with over half (9) located in the Nyalenda neighbourhood where the model was first implemented. KIWASCO is the primary utility provider, with multiple intermediate distributors (Figure 3). Of the 29 interviewed vendors, all were selling water from KIWASCO. MOs and tanker trucks get their water directly from KIWASCO at a bulk rate. This water is then either conveyed directly to the consumer or is purchased by household resellers, kiosks, motorcycle drivers, and handcart for onward distribution. Because our chain referral sampling methods focused on drinking water, it is possible that other supply chains exist, such as the collection and sale of river or lake water for non-consumptive purposes like car washing.

Outside of the DMM, there are multiple different types of water vendors in Kisumu that have different coordination mechanisms with KIWASCO (Figure 3). Handcarts and household

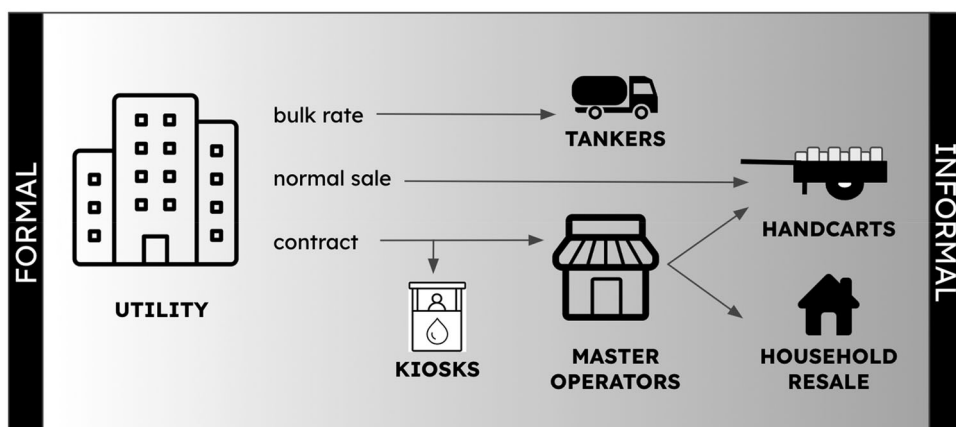


Figure 3. Kisumu’s has multiple water supply chains that may be formal (i.e. the utility), informal (i.e. handcarts and household resale), or hybrid (i.e. tankers, kiosks, and master operators).

resale receive passive recognition, as the utility does not formally engage with them nor interfere with their activities. Tanker trucks have a customer-client relationship where the utility sells water at preferential rates. Finally, MOs have formal contracts with the utility. In this section, we describe the boundary and choice rules for each type of vendor. Information rules are explored in the next section.

To understand boundary rules, we asked the different vendor types whether there were any formal or informal rules regarding who is eligible to become a vendor. The only formal, written rules are the eligibility criteria to become an MO. Some MOs say there are factors beyond the written rules that may influence success, functioning effectively as social norms – such as being a member of the community you serve, having connections with utility staff, and possessing knowledge or experience related to water provision. For the handcart vendors, boundary rules are norm-based, as they have no direct interactions with the utility. Because they must either rent or own their equipment, financial means constrain who can become a vendor. They often reside in the same communities as their customer base, which allows them to understand their community's water needs. Handcart vendors must be physically able to push their carts, and respondents correlate this physical strength with gender. While the tanker operators had more interactions with the utility at the filling points, they also face financial barriers to entry: only one owned his truck, which took him 3 years to purchase, and he needed a loan to make this possible. The others operated the trucks as drivers working as employees of the tanker owners. Gender was also mentioned for tankers, who said that men have an advantage over women, but did not specify as to why.

In terms of choice rules, a competitive market limits vendors' ability to set prices or control a given service area, but some variation cannot be explained by market forces alone. For MOs and kiosks, service areas are designated by KIWASCO, and prices are predetermined in their contracts. The relationships between a vendor and their client often matters for handcarts, as they often respond to customer calls. About half use the rate agreed by all vendors, although some charge lower to attract more customers. Handcarts make decisions on where to sell based on expected demand, often by selling in populated areas without pipes, and consider distance and the quality of roads when setting their prices. The presence of non-profit projects has increased competition, as they charge lower rates. The handcart operators we interviewed make between 5-15 trips per day, with both the rate charged and the distance travelled depending on the area served. For example, handcarts in the central business district travel a maximum of 300 m, while those in urban Manyatta travel a maximum of 500 m, and those in peri-urban Nyamasaria will travel up to a kilometre. Tankers will sell to anyone who calls them, including high-income clients within the area of an MO. They charge based on a fixed base rate and a transport rate that increases with distance. On average, the four tanker trucks interviewed travel between 30–40 km, and make 2–3 trips per day. All mobile vendors confirm that other vendors serve the same area, with varying densities across the city.

4.3. Dynamics of trust

One of the main concerns related to informal water vending is that high prices get passed onto low- and middle-income consumers. There is high variation among different types of vendors in terms of the cost of the water they purchase, and the prices they then charge to consumers (Table 2). Distributing vendors increase their prices with distance from their water source due to the additional labour and transport costs. For example, borehole users in peri-urban Buoye supplement drinking water from KIWASCO, but this must be ordered or fetched from the nearest point 3 km away.

The quality of water has decreased in recent years, with climate change and pollution from agriculture and industry leading to a high nutrient load and algal blooms in Lake Victoria (Secaira Ziegler, Roegner, Aura, & Fiorella, 2023; Juma, Wang, & Li, 2014). KIWASCO

Table 2. Different types of vendors pay different prices for their water, which affects prices charged to customers

Vendor type	Cost of the water at the source	Prices charged to the consumer
MO	60 KSH/m ³	75 KSH/m ³
Kiosk	60 KSH/m ³	125 KSH/m ³
Household resale	75 KSH/m ³	150–250 KSH/m ³
Tankers	80 KSH/m ³	350–800 KSH/m ³
Handcarts	104–208 KSH/m ³	250–1500 KSH/m ³

struggles to treat the water to an acceptable quality, and the odour from the lake affects users' confidence in the water at their taps. Consumers have low confidence in both vendors and the utility to deliver good quality of water. Vendors perceive that the quality of water they purchase from the utility has deteriorated since they have been vending, with some saying the water quality is inconsistent, fluctuating between good and poor. However, vendors still rely on the utility water, as other sources are unsafe: rivers are affected by pollution, and the fluoride and chloride content in most boreholes are above the recommended values for both the World Health Organisation and the Kenyan Bureau of Standards (Kanoti et al., 2019). One user described borehole water in Buoye: *'when it's used to cook porridge, it turns yellow, and when used to cook food and left overnight, it starts foaming'* (C017). Several vendors noted challenges with water-borne illnesses, especially during the dry season when users start supplementing with the polluted river water (2 in Nyalenda) and wells (2 in Manyatta).

Water quality challenges in the lake disrupt reliability of piped water due to treatment issues and tank cleanings. This is exacerbated by climate-related challenges at the Kajulu River intake, as seasonal flows have lowered in recent years. Vendors noted a decrease in reliability of water and challenges with low water pressure. Though consumers perceive that water is increasingly available, many still reported insufficient water within the month preceding our interviews, noting frequent disruptions. In the urban areas relying on KIWASCO water, disruptions are mostly attributed to maintenance, as the age and fragility of infrastructure in Kisumu leads to frequent pipe bursts. In peri-urban Buoye, consumers noted foregoing water due to expense, rationing, and power issues causing borehole disruptions.

Consumers have low trust in the utility, and express more optimism that vendors try to be helpful and look after the needs of the community. Consumer trust in vendors is influenced by social trust, including better procedures and more frequent interactions, and consumers feel more empowered to fix their problems with vendors. Consumers also trust vendors more than utility to have water available. However, they do not think that vendors charge fair prices, which some attribute to the distance they cover while others think it is an injustice rooted in profit motives. One user noted that *'young beautiful ladies are favoured because of sexual favours'* (C09), echoing a key informant's concern that sexual exploitation may be an issue in Kisumu. The quality of water is a major source of distrust in the utility, alongside pessimism about complaint resolution, as most consumers have made complaints about their water to KIWASCO, which were often not resolved. Consumers think that corruption is not as rampant as before but suspect some mismanagement of funds—for example, residents without any utility coverage suspect that community leaders may be embezzling the funds that were meant to bring utility water to the area.

Vendor trust in the utility is aided by improvements related to more water availability, better communication around disruptions, and helpfulness related to technical assistance. However, some vendors feel a lack of justice regarding agency, engagement, participation. These vendors feel that engagement efforts are not meaningful, and consultations have predetermined outcomes. For example, they noted strained relationships between the utility and the MOs because

contracts are strict with little room for input. Some handcart vendors share these frustrations, such as the recent tariff adjustment: *'The current management does not do public participation but rather comes up with policies and forcefully implements them— like the price increment'* (V020). Across vendor types, distrust in other vendors stems from the competitive nature of the business, such as when other vendors sell below the agreed rate to attract customers. MOs have low trust in other vendors, as disagreements about service area boundaries have resulted in the MOs taking each other's customers, or illegally connecting to other MOs lines. Billing conflicts are a challenge for MOs, who struggle with users rejecting high bills or threatening meter readers. In contrast, handcarts operate more independently, and benefit from a lack of utility interference and upfront payments. Though the current management has improved corruption challenges, some vendors raised concerns around procedural aspects, such as the poor management of complaints, or injustices related to billing issues, harassment, favouritism, mistreatment, and bribery.

Key informants alluded to the trust that has been built between the utility, the city, and the water vendors. The lack of interference with handcarts is attributed to their performance, as public health authorities inspect vendors' water samples for quality: *'If there is actually a danger, then we shall come up with a policy ... if there's no problem, we encourage them to continue'* (KI19). Utility staff point to the importance of involving communities in water service provisioning, *'devolving it right to the grassroots'* (KI07). While the DMM has helped incorporate problematic cartels into the water delivery system, utility staff are concerned over their resurgence, and have discouraged vendors from forming associations. 'Activism' among MOs has the potential to create conflicts if they request changes that are beyond the scope of the utility to control— for example, in the case of tariffs, which are mandated by the national regulator (KI10). During such conflicts, it is the users who are at risk of suffering from water cut-offs.

5. Discussion

We return to our research question: how does coordination between the utility and informal water vendors affect the performance of co-produced water services? The DMM offers opportunities to leverage community relationships to support the delivery of safe and affordable water through a partnership approach. By expanding water supply through this coordinated arrangement, the utility was able to extend the reach of the network to places that had been historically difficult to access. Our analysis highlights the importance of social aspects of trust for both the utility, vendors, and consumers, as social aspects of trust helped reduce challenges that the utility faced with water cartels, while social networks remain helpful for consumers to resolve problems. While previous research has pointed to the role of vendors in achieving distributional justice, our results point to the ways in which vendors also help achieve procedural and interactional justice.

Our results suggest that trustworthiness of water supply networks is linked with access to decision-making and community relationships, supporting theories that institutional trust is tied to social trust and affected by cultural issues (Godefroidt et al., 2017; Kaasa & Andriani, 2022). This also supports performance theories that see social equity as a missing link in understanding the relationship between an institution's performance and citizen's trust, as the trustworthiness of water supply networks is closely related to social equity concerns (Lee, 2021). Our findings align with those of Munro and Kweka (2021) in Dar Es Salaam, who show the importance of social accountability in establishing trustworthiness.

Though the DMM has improved outcomes for consumers, there are opportunities to improve the institutional arrangements for vendors, who expressed discontent with a lack of participation at the utility level. Contracted vendors have low trust in each other, and vendors who operate informally have better business relationships with other vendors, pointing to possible improvements in the business relationship between the utility and MOs that is sensitive to their

business needs. For example, a better understanding of the MOs' profit margins over time could shed light on their investments, leading to targeted financial support or business-related training. Existing arrangements risk creating a 'race to the bottom' as MOs feel pressured to accept contract terms because they fear losing a business opportunity. Changes to the utility's contracting process could enable better responsiveness to vendors' needs and mitigate recurring issues such as financial mismanagement.

Our results also show that informal settlement residents still rely on handcart vendors who operate informally. One of the most surprising findings was the wide range of perspectives among key informants regarding the handcart vendors: some denied the presence of handcarts entirely, while others referred to them as essential players in extending the piped water supply. Many participants held the opinion that handcart vendors will be gradually phased out as the water supply increases, but this is unlikely to be achieved in the short- to medium-term. The importance of social trust suggests that handcart vendors may be valuable partners in extending water supply, especially as vulnerable residents feel distrustful of government actors. Because they are closer to the communities they serve, these vendors are better positioned to be proactive, responsive, and flexible to the ever-changing needs of their customers. Government and utility actors might consider ways to leverage vendors in building trustworthy relationships, using partnership approaches that lower the financial and health risks for communities.

As formal systems are unlikely to keep pace with demands worldwide, experience in Kisumu highlights opportunities for co-produced water services that can harness the potential benefits, and minimise risks, of the informal water sector. Targeted subsidies or reimbursement schemes for these vendors may greatly reduce high water costs for the poorest consumers, while targeted support may improve health outcomes. Further research could use representative sampling methods to create a more comprehensive picture of the water supply infrastructure in Kisumu, with the opportunity to include the perspectives of institutional consumers and middle-class households who purchase water in bulk from tanker trucks.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

Data availability & supplemental materials

Our data collection instruments are included as supplementary materials. The interview data supporting the findings of this study are not publicly available to protect the confidentiality of participants according to our ethical protocols. Access to the data is restricted. Any requests to access anonymized data or specific data points can be made to the corresponding author, subject to alignment with ethical guidelines.

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