www.water-alternatives.org Volume 18 | Issue 1

Jeppesen, M.D. 2025. Fluid authority: Exploring hydraulic social contracts in Nairobi's water provision. Water Alternatives 18(1): 86-102

Fluid Authority: Exploring Hydraulic Social Contracts in Nairobi's Water Provision

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ABSTRACT: This paper aims to expand our understanding of the diverse relationships in water provision in cities such as Nairobi, where urban water is provided through heterogeneous actors and through piped and non-piped systems. The paper contributes to the study of authority and urban infrastructure by examining how interactions between urban water systems, their providers, and the people who depend on them shape forms of authority emerging around urban water. The paper draws on insights from an ethnographic study conducted in an informal settlement named Kibera and in Langata, another residential area of Nairobi, Kenya. It examines the forms of authority that are created around water service providers and whether the concept of "hydraulic social contracts" adds to our understanding of relations of authority in service provision. The fluid materiality of water, fragile material infrastructures, and their social embeddedness tie into fluid relations of authority where water service providers embody seemingly contradictory roles defined by exploitation and solidarity. The paper concludes that hydraulic social contracts are particularly precarious and that relations of authority based on water are difficult to fix into static conceptualisations.

KEYWORDS: Authority, water provision, social contracts, infrastructures, Nairobi, Kenya

INTRODUCTION

The forms of authority around water provision in Nairobi that are produced in the nexus between water, infrastructures and social structures encourage fluid and situational understandings of authority. This is the central finding of this paper and is based on examples of interactions between water providers and residents in two different neighbourhoods of the city.

Water in Nairobi is provided through various actors and infrastructures, government-controlled and not, piped and non-piped. The cityscape of Nairobi would not be the same without the blue water trucks with 'CLEAN WATER' written on the side, spilling water as they turn a corner or make a sudden stop. The same goes for the colourful and tangly plastic pipes sometimes referred to as 'spaghetti pipes' that provide water to the city's so-called informal[1] neighbourhoods. The relations between the actors controlling the water and the people in need of it are key to shaping social and political structures and patterns of inequality as these relationships determine who get what on what terms (Barnes, 2014; Reyes Escate et al., 2022; Swyngedouw, 1997; Swyngedouw et al., 2002). This paper aims to expand our understanding of some of these diverse relationships in water provision. It contributes to the study of authority and infrastructure by examining how interactions between urban water systems, their providers, and the people who depend on them shape the forms of authority that emerge around urban water.

[1] I refer to the concept of informality only as an emic concept that is used in Nairobi to describe the non-planned areas of the city, where people do not have statutory legal claims to the land or to state services. These are also commonly referred to by its residents and others as 'slums'.

I pursue the idea of 'hydraulic social contracts' by examining these provider – consumer relationships through Lund's (2016) understanding of social contracts of recognition. This concept theorises that authority is constituted through the recognition of claims to resources. To nuance the understanding of public authority, I also draw on Olivier de Sardan's (1999) work on the moral economy of bureaucracies. I show that the fluid qualities of water and the fragility of the infrastructures mediating its provision make the forms of authority created around it fluid and situational. This fluid relationship between water, infrastructures and social relationships creates hydraulic social contracts of solidarity and exploitation, inviting dynamic understandings of authority. In the same way that water defies complete control, so too do the relationships between water service providers and residents, eluding more static conceptualisations of authority such as the social contract. Pursuing the idea of hydraulic social contracts, we can see that the kinds of resources that people make claims to are fundamental to the relations of authority that then emerge. Hydraulic services thus call for a dynamic and situational understanding of authority.

The article builds on 12 months of ethnographic fieldwork in Nairobi that took place between November 2021 and February 2024. I have talked to residents and various actors involved in the water provision sector, conducting semi-structured interviews, transect walks, informal conversations and participant observation. I draw on fieldwork from two areas of Nairobi: the residential area of Langata where people are connected to the grid but must often find supplementary water sources due to inadequate supply, and the informal settlement of Kibera where people cannot get a domestic connection to the state-regulated grid and must thus rely exclusively on other sources. The fieldwork included a variety of actors and the empirical material that I draw on takes many forms; these include: 17 interviews with 11 different water vendors and fieldnotes from those interactions; a focus group with water carriers; 10 interviews and a focus group with Langata residents; interviews with chairpersons of 6 estate committees in Langata; 7 single interviews and 4 focus groups with Kibera residents; interviews with 3 community-based organisations (CBOs) in Kibera; and fieldnotes from 3 months of bi- or tri-weekly shadowing of Nairobi Water field employees, one of these being the distribution team. All names and identities have been anonymised. By examining the similarities and differences between Langata and Kibera, each with its dominant infrastructural systems, I wanted to gain a deeper understanding of the relationships fostered by these providers and provision systems. I focus on water trucks, on employees of the state-owned utility company Nairobi Water in Langata, and on non-state water vendors in Kibera. Because of lack of access and time constraints, I did not talk to water truck operators or owners; the part of the analysis that focuses on truck supply thus draws more on residents' perspectives. While I followed the work of Nairobi Water employees extensively, this paper is based predominantly on residents' own struggles with, and stories about, them, as this kind of data has been more fruitful for understanding the similarities and differences in the relationship between the water officials and residents. In Kibera, on the other hand, I draw examples and perspectives from both residents and vendors.

In the following section, I explore perspectives on the connection between public authority and claims to resources, and the role of infrastructure in this dynamic. I then outline the two study sites and their infrastructural systems. In the subsequent section, I analyse the relationships formed around water trucks and water distribution in Langata. The next section explores the relationships of authority constituted between water vendors and residents in Kibera. I then discuss the moral economy of water provision and the role of infrastructure in fixing fluid relations of power and authority. The final section offers concluding remarks.

RESOURCE GOVERNANCE AND AUTHORITY

There is a deep connection between authority over, access to, and control of resources such as water (Milgroom and Ribot, 2020; Rasmussen and Lund, 2018). Service provision mediates a relationship between those in control of a resource and those in need of it; this tends to be an uneven relationship

that can take many forms (Cleaver, 2017), one such form being the constitution of public authorities (Sikor and Lund, 2009). The social contract, as proposed by Christian Lund (2016), is a concept that deals with the link between authority and claims to resources; it has gotten much traction in academic discussions on non-state governance. It deals with how authority is constituted through the recognition of claims to resources. Lund argues that when citizens seek to have their claim to a resource legitimised through an organisational entity, they acknowledge its authority to recognise that claim. By sanctioning that claim, conversely, the organisation acknowledges them as rights-bearing citizens (ibid). The process of claiming the right to, and control over, resources in this way establishes a relationship of recognition between the claimant and the organisation. Anand (2017) describes a similar dynamic in water provision, where a connection to the utility grid is a way for people to be recognised and to establish themselves as rights-bearing citizens. The social contract does not exist only between a state and its citizens, it can also be constituted with any form of organisational entity (Lund, 2006). Public authority therefore resides not only in state institutions, but also anywhere that people acknowledge an organisation or organised group as having the capacity to recognise a claim. This is seen, for example, in places where the presence of statutory institutions is low, such as in urban slums where non-state organisations that provide citizens with basic services may acquire state-like qualities (Büscher, 2012; Harnischfeger, 2003; Stacey, 2019). Authority thus implies a relationship of recognition as opposed to power, which I understand to be a more general influence one individual has over another (Uphoff, 1989). I draw on a loose notion of organisations, capturing both statutory organisations, companies, and groups of actors with varying degrees of legality.

There is extensive literature on the constitution of authority through resource control, where the focus is on claims to, and control over, land (Eilenberg, 2022; Lund and Eilenberg, 2017; Peluso and Vandergeest, 2001; Setyowati, 2020; Titeca et al., 2020; Tsing, 2003). Given its materiality, however, and the way it has been assembled as a resource (Li, 2014), addressing the question of authority over land, calls for some specific understandings of access, ownership, and recognition of claims. Material 'things' have differences that make a difference in terms of how they enable and constrain social relations (Bakker and Bridge, 2006, 2021). Against this background, and through examining cases of water provision in Nairobi, I want to explore which forms of relations of authority emerge around urban water and water infrastructures, and who are the actors in control of them. For this I draw on, and nuance, the concept of social contracts, specifically pursuing the concept of 'hydraulic social contracts', that is, contracts of recognition that form around water provision.

Water has been defined as an unruly or uncooperative resource in terms of its fluidity and constant movement (Bakker, 2003; Dewan and Nustad, 2023); it leaks and flows and calls for specific infrastructures and pressure in the process of being provided to urban consumers. The materiality of the resource also gives rise to certain conditions for access and exclusion (Dewan and Nustad, 2023). This is especially the case because it ties to ownership and property, which, according to Strang and Busse (2020), require a certain degree of material stasis. Although recent work has highlighted the multiplicity of land claims (Meinert and Whyte, 2023), claims to land ownership have *relative* stability when first asserted, as it is a resource that is "eminently tangible and holdable" (Strang and Busse, 2020: 177). Urban water distribution depends on the control and governance of a *flow* through infrastructural systems. For this reason, infrastructure becomes central to an examination of water governance and the forms of authority arising from it; it also determines the ways in which water becomes interrelated with organisational forms and governance practices (Bakker, 2012).

Water systems and water control in most Global South settings are heterogeneous and, globally, the traditional ideal of a centralised grid system holds in very few settings (Smiley, 2020); water control is instead dispersed across a variety of actors and infrastructures (Furlong and Kooy, 2017; Acey, 2019; Dakyaga et al., 2023; Lawhon et al., 2023; Narain et al., 2023). The idea of being able to distinguish between state and non-state water provision regimes according to whether or not they rely on specific infrastructures is challenged by Narain et al. (2023), as they show that piped water supply is not limited

to governmental or state domains but is also provided by non-state actors and that non-piped water provision systems also exist in state and non-state regulatory frameworks. Neither does the degree of formality in water provision inherently determine the quality of services, as Boakye-Ansah et al., (2019) illustrate with their paper on the formalisation of informal water provision in Kisumu, Kenya. This heterogeneity and blurriness of water domains and systems is also evident in places such as Kibera and Langata, where an examination of the water infrastructures reveals a mix of piped and mobile systems; all of these heterogeneous water provision systems rely heavily on social negotiation, as is further confirmed by the 2023 study by Narain et al., in Delhi, India.

We can understand infrastructures as built networks that facilitate the flow of goods, people or ideas, and allow for their exchange over time and space (Larkin, 2013). There is an extensive body of literature dealing with how infrastructures, through the relationships established in the exchange of goods and ideas, tie to negotiations around state authority and citizenship (Fredericks, 2018; Harvey, 2014; Lemanski, 2019; Kooy and Bakker, 2008; Pilo, 2017; von Schnitzler, 2013); there are also notable contributions on water provision by, for example, Meehan (2014), Ranganathan (2014), and Anand (2017). Despite the extensive literature on non-state and non-grid infrastructures, there is limited exploration of the relationships these providers have with consumers, particularly from the perspectives of authority and recognition. A noteworthy exception is Truelove (2021), who argues that vital infrastructures such as water systems are an organising force by which city dwellers and state and non-state political actors understand and exercise everyday governing power. Although dealing primarily with residents and the state, Anand's study of water provision in Mumbai also offers useful insights into the cyclical and iterative relations of authority and citizenship that are created through "social histories, political technologies, and the *material-semiotic infrastructures of water distribution* in the city" (Anand, 2017: 9; author's emphasis). Infrastructures such as water pipes serve to establish connections between people, which then evolve into relationships of power through the provision of essential resources (Swyngedouw, 1997). In such ways, infrastructures define water access and control not only in material, but also in legal and institutional, terms (Hommes et al., 2022; Rodina and Harris, 2016; Wittfogel, 1957). This points to the central role of infrastructures in shaping political relationships of authority, within as well as outside of the state.

The social embeddedness of water systems is another critical dimension of this study. Alba et al. (2019) show through their study in Accra, Ghana, that water distribution and quality are shaped by the identities, emotions and positionalities of the individuals involved in the distribution and by the infrastructures they utilise. Importantly, people's political belonging and their relationships with authority are not shaped solely from the top down through infrastructures. Wamuchiru (2017), for example, highlights how marginalised residents in Dar es Salaam, through grassroots mobilisation and communally organised water projects, create their own spaces of agency within water provision, thereby instigating institutional changes and alternative infrastructures outside of the state.

To emphasise the social and moral dimensions of the intersections between infrastructure, power, and water governance, I draw on Olivier de Sardan's (1999) concept of moral economy which captures how people (in this case bureaucrats in West Africa) are guided by seemingly contradictory rationalities such as solidarity with their community and a felt obligation (when given the chance) to enrich themselves and their family at the cost of the community. Olivier de Sardan describes how practices which may go against a formal code of conduct occur because they are embedded in complex social processes where logics of negotiation, solidarity, predatory authority, and redistributive accumulation take place (Bierschenk and Olivier de Sardan, 2014; Olivier de Sardan, 1999). As I will show, the concept of a moral economy provides a valuable lens for expanding and nuancing dominant perspectives on authority and its ties to claims over water systems.

STUDY SITES AND THEIR DIFFERENT INFRASTRUCTURAL SYSTEMS

Langata

Water provision in Nairobi is highly differentiated between wealthy and more marginalised areas (Kimari, 2021; Mutono et al., 2022). Nairobi residents rely on a diverse range of infrastructures and water providers that are both entangled with, and disconnected from, the networked system. This system is managed by the utility company called Nairobi Water and Sewerage Company (generally referred to as Nairobi Water), which is owned by the local government (Kasper and Schramm, 2023). The water in the networked system comes from dams north of Nairobi; it is treated at one of the city's treatment facilities and then distributed via the underground grid to the seven regions served by Nairobi Water.

The rapid increase in Nairobi's population has put considerable pressure on the city's resources and the current dams can supply only 525,600 cubic metres per day (m^3/day), compared to a demand of 820,000 m^3/day (Interview with Nairobi Water official, April 2022). Further scarcity is caused by deteriorating and leaky infrastructures. Water provision in the central piped system is therefore rationed and most households have water in their taps only one to four days a week and hence rely on stored water. By manually closing and opening valves around the city, Nairobi Water can ensure that water flows according to schedule to particular areas of the city on specific days. The valves are located along the roads and a distribution team uses big keys to turn them every morning and evening.

The study site of Langata is no less challenged on water security than the most of the city. Langata is a constituency within Nairobi city which, as per the most recent census, has about 197,500 residents (KNBS, 2019). It borders Kibera to the southwest, and the area is a mix of lower- to upper-middle-class residents living in everything from one-bedroom tin-roof houses to apartment buildings and large villas. Many people live on estates, that is, gated communities of varying sizes that are organised around service provision and other needs. Being deemed a formal area by the state and the water service provider, most houses are connected to the main grid with individual meters, or with a communal meter for shared compounds where several tenants pay for water through their rent. The technical manager of Nairobi Water's office for the Southern Region, within which Langata is located, calls Langata "the desert of Nairobi", by which he means that the area is located at the tail end of the supply network. According to him, only 40% of the water demand can be met by Nairobi Water and people are regularly forced to find alternative channels for sourcing water, to which water trucks (also called tankers or bowsers) are quite central. Like the rest of Nairobi, the residents of Langata thus also rely on a heterogenous assemblage of water provision systems that are entangled with, but not solely reliant on, the networked system (Kasper and Schramm, 2023).

Kibera

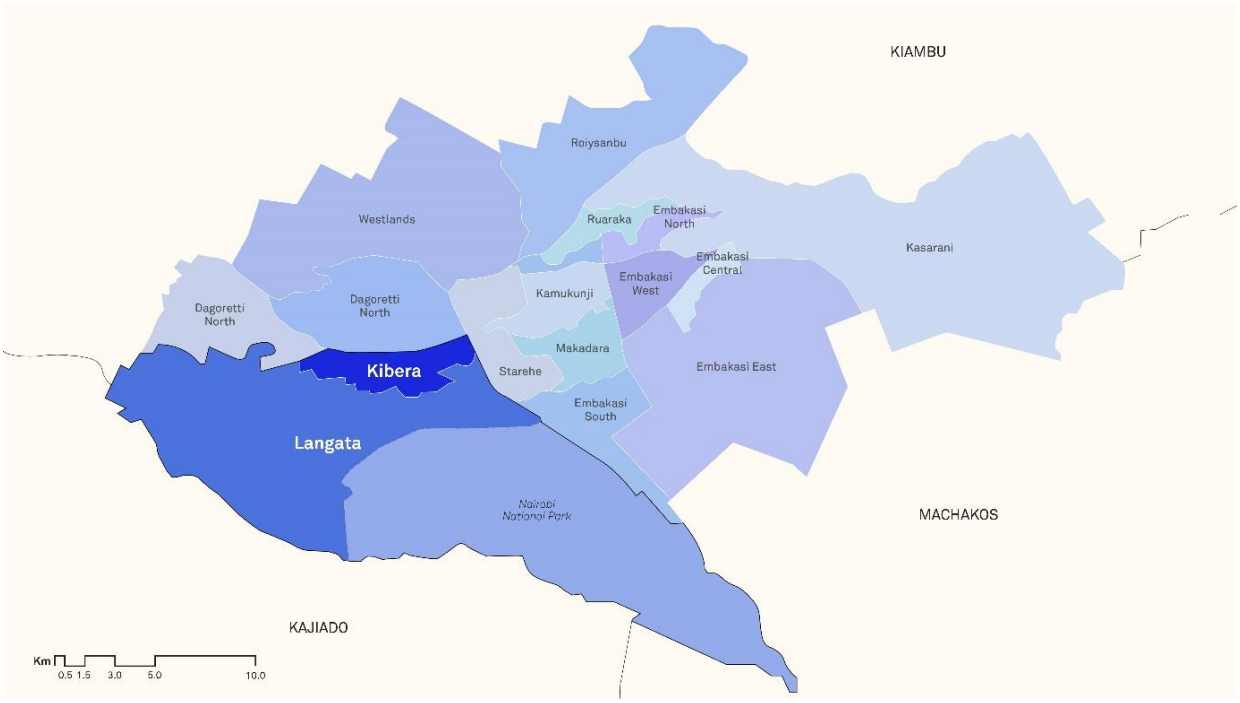
In the informal areas of Nairobi, people cannot obtain domestic tap connections due to lack of formal land tenure, thus alternative modes of provision are dominant. This is the case in Kibera, Kenya's largest informal area. The settlement is in the southwest of Nairobi and is estimated to have about 250,000 inhabitants, though some estimates suggest more than a million (UN Habitat, 2020). In Kibera, water is provided by private vendors and by various NGOs; in both cases from water kiosks where people buy water in 20-litre jerrycans. In 2024, water that was being sold at kiosks was typically priced at 10 KES (approximately US$0.077) per jerrycan, which is 10 times higher than the cost of water accessed via a grid connection with Nairobi Water. As reported by residents, the price can surge dramatically, reaching 40 to 50 KES per jerrycan during droughts or following disconnections of unauthorised connections.

Most water in Kibera is diverted from the state grid through plastic pipes, unmetered and unregulated. In this way, it is an extension of the grid operated by Nairobi Water, only with a higher degree of flexibility as the pipes are routinely disconnected, changed, vandalised or washed away by rain. Successful vendors can gain a form of monopoly over water resources in specific areas and can create artificial scarcity in

order to hike the price of water. Despite most vendors saying that you cannot be friends with your competitors, there is a form of organised collaboration between many of them, especially when it comes to confrontations with Nairobi Water and setting a price for the water. This control of the Kibera water sector has led residents and Nairobi Water employees to give the (predominantly male) water vendors the broad term of 'cartels'.

To stay in business, vendors need a secure connection to a reliable and pressurised pipe. They therefore go to great lengths to conceal the route of their pipes in order to make it difficult for others to identify the pipe and its source. Vendors have a trained eye for spotting where water lines may be coming from. When accompanying a vendor, one can observe their eyes to be constantly darting over the ground to see whether any new water connections have made their way to their area.

Figure 1. Map of Nairobi, with Kibera and Langata to the southwest.



Source: Google Maps.

In the two areas, I examine the relationship between consumer and provider and explore which forms of authority are constituted around the water tankers and the spaghetti network. While both Kibera and Langata rely on a meshwork of piped and non-piped infrastructures controlled by various actors, different systems prevail and dominate in the respective areas; in Kibera, water kiosks managed by vendors are dominant, and in Langata grid connections are supplemented by water trucks. Different conditions are thus created in the two areas within which people claim water and engage with the water providers; these conditions, in turn, create different forms of authority around water. In Langata, people rely on the underground network which should, in theory, deliver water according to an official schedule without much human interference. The pipes are deep underground and cannot be easily tampered with; however, the valves through which the water is directed around the city are vulnerable to manipulation. As we will see, claims to water become dependent on engaging with the actors who control these valves. The water trucks, by comparison, are less anchored to a stable infrastructure and there is little on which to base accountability and reliable water claims. In Kibera, on the other hand, the pipes are more accessible, but they are structured into a rather complex and dynamic system that is controlled by the

ubiquitous water vendors. Residents' claims to water are dependent on engaging with these often-exploitative vendors, however, the way in which the vendors and their pipes are embedded in the community can give the residents some limited leverage to make claims to water.

I deal only with some of the many water provision services on which people in Nairobi rely. More than half of the city's population, however, lives in informal settlements and depends on non-state entrepreneurs, and most formalised residential areas have domestic water connections and use water trucks only from time to time. A substantial part of the population thus relies on either the water vendors or the water trucks. Through the study of the two areas, I build on existing work to expand our understanding of how infrastructural systems shape the opportunities for, and obstacles to, exerting social and political pressure for water services (Schramm and Ibrahim, 2021). In studying the everyday interactions (and lack thereof) between water provision actors and residents, I follow Rusca and Cleaver's (2022) call for focusing on everyday practices to understand social differences and processes of exclusion and inclusion in urban water provision.

LANGATA: ELUSIVE INFRASTRUCTURES AND RELATIONS

Water conspiracies

In Langata, the route of the water flow is often blurred and obscured, even when it comes through the grid. In some areas, water often does not come on allocated days. Many Langata residents believe that the problem lies with the valves that are turned on and off daily by the Nairobi Water distribution team to direct the water to different areas of the city according to the rationing schedule. A chairperson of one estate committee, suspecting distribution team employees of causing water issues, spent a week trying to catch them in the act of turning valves, however they always managed to enter the estate unnoticed.

Because it is controlled by people, the infrastructural system is entangled in social life. This becomes a source of mistrust as residents become suspicious of the motivations guiding the water provision actors. This is particularly clear in the Whatsapp. chat for residents in the Ngei 2 Estate, where issues around water are the main topic of discussion. To quote a Whatsapp. message from April 2023:

> There is a person who decides to open and close. This person is the same who will decide the hours we will have water (…). You who rations our water on extension way is lucky because am sure you get your supply as and when it's supposed to come. This is very very unfair.

The invisibility of the flow of water through the piped network leads to a lack of trust that valves are being turned on and off according to the official schedule. This results in at least some antagonistic relations as people do not know who is directing the flow of water and on what basis or schedule. Another example of an opaque sociomaterial infrastructural network hindering people's ability to claim water services was the water struggle related to a plot in Langata where a man named Sylvester, and his neighbour Boaz, lived. Sylvester had been renting a house in Langata for the past seven months and, throughout this period, water had come only once in the tap he shared with the other tenants on the plot. He explained that water supply was part of the rent, but that the landlady, who (as property owner) was responsible for dealings with Nairobi Water, would be evasive as to why there was no water. Sylvester and Boaz had suspicions that the landlady was working with the vendors who were selling water in the area. In the interview, they described the difficulties they had encountered in trying to solve the water issue, one of which was just locating the valve that controlled the compound's water inflow. The landlady had refused to show the tenants where it was, which made it almost impossible to investigate the water issue on their own. The valves, in these cases, make the grid vulnerable; lack of accountability regarding their operation obscures who decides the flow of the water and on what basis, which challenges claims to water.

Mobile infrastructures and the lack of relations between providers and consumers

The water trucks that people call to fill up their water storage tanks for when the grid fails appear to create similar relations of mistrust. As the study revealed, this distrust arises partly from the suspicions held by most residents and estate chairpersons that truck owners collude with the distribution team. This distrust is illustrated by this example from a May 2023 Ngei Whatsapp. chat:

> The issue of [the] water problem is an internal problem caused by brokers staying within the estate and not supplying [our] piping systems. Our investigation points to some particular individual(s) who act as brokers of water boosters [trucks] and the Nairobi Water and Sewerage personnel. Please stop it.

The obscurity concerning the blue water trucks is further exacerbated by the fact that some of them are owned by Nairobi Water and some are not. In this way, it is unclear exactly how Nairobi Water is involved, who owns the trucks, or where their supply is coming from. As a resident of the Akiba estate said in an April 2023 interview, "We don't know the source of the water. Where it comes from. And [you get] water that is contaminated". Mobile infrastructures such as water trucks blur the connection between the water source and the consumer. It is difficult to discern how far the water has travelled from the state treatment facility or whether it has come from there at all. While some trucks are filled from fire hydrants or from other sources supplying the grid, they are also filled from boreholes, some of which is treated water and some not. Residents describe how the water is sometimes salty and at other times is visibly dirty. Another issue is pricing, with tanker water tending to be around five to ten times the price of the water that people receive through their water connection.[2] According to residents, lack of accountability means that ensuring water quality is based on social connections. As a Langata resident named Andrew told us in an April 2023 interview, "I've heard that the tankers don't source the water from clean sources. So you have to find a reliable person to buy from. You need somebody who can vouch for the tanker".

The relationship between providers and residents is full of mistrust while simultaneously hinging on existing social networks of trust. This shows how an alternative mobile water source such as the water tanker gives no accountability, as people cannot know the source of the water. The lack of stable relationships points to a weak social contract between water truck operators and residents, as this water provision establishes a weak recognition of the residents' claims to water and produces very limited legitimacy for the truck owners. The water service provider's reliability must be established individually through relations of trust in a context that is characterised by much mistrust. Water access becomes based on a moral economy (Olivier de Sardan, 1999) of exploitation and social networks.

The water challenges people face are thus rooted in manipulable infrastructure, local trust-dependent social connections, and unequal relations between water providers and their consumers. In this context, actors unknown to the residents become influential in controlling the water supply and the emerging alternative water infrastructures. Similar to the vendors of Kibera, the actors who interfere with and/or influence the water sector gain the nickname 'cartels', which Kenyans use to describe many sectors and industries. Both the mobile water trucks and the hidden valves that have to be turned on and off by a team that moves and operates when residents are sleeping add to the lack of a social contract of recognition (Lund, 2016) between provider and consumer.

KIBERA: SITUATIONAL RECOGNITION AND EXPLOITATION

In Kibera, as in Langata, influential actors use the manipulable nature of water to further establish their position. In Kibera, the water kiosk vendors' obscure and tangled system broadly defines access to water. The factionalised and sometimes rivalrous individuals who make up that group are almost entirely in control of the water provision system in the settlement. Through this study, I show that the opacity and

[2] The cost of 1000 litres of water from a grid connection is 53 KES (US$0.41), while 1000 litres bought from the water kiosk is 250 to 500 KES (US$1.93 to 3.87), at 5 to 10 KES per can.

transactionality of Kibera's relations between water providers and residents is similar to what is observed in Langata. Vendors in Kibera, however, with their kiosks and pipes, become even more intertwined with the community's social fabric through dynamics of recognition and exploitation.

Water patrons

In the way that they provide basic resources to the residents, the water kiosk vendors take on roles and qualities that are generally associated with the state; indeed, many Kibera residents trust the vendors more than the government for water provision. In a March 2023 focus group with five women in Kibera, I asked whether they would want water in Kibera to be fully formalised. One of the young women said promptly that she would prefer the water vendors. "You can't rely on Nairobi Water. Their water doesn't come often, and you might not be available when it comes. There are so many chores during the day, so it is tough if you have to adapt to specific times for water". Her friend added that relying on a state water supply would be unhygienic since the irregularity of the government's supply interferes with washing and cleanliness. Water from vendors, by contrast, while expensive and of dubious quality, is almost always available. Some Kibera residents thus view the vendors as more reliable water providers, though there is undoubtedly also widespread dissatisfaction with them among residents.

Despite finding the vendors problematic, people generally acknowledge their centrality to the provision of water. Vendors have thus been somewhat successful in having the community accept their control over the water. In March of 2023, after Nairobi Water disconnected many of the vendors' connections, I did a focus group with a community-based organisation in Kibera, where the members explained the importance of the illegal connections and told me that the most important thing for them was to receive water. As one participant put it, "Maybe we didn't know where those connections were coming from, but at least we were getting water". The discussion was about the lack of legal sources of water, and that participant pointed to how reliability is of greater importance than the source. In that sense, the kind of authority that vendors establish on the basis of their role of controlling access to water in the community does have a degree of recognition. We see this in Lund's (2016) social contracts, as they are recognised as at least addressing the community's water needs. A relatively steady flow and a reliable acknowledgement of people's water needs leads to something that is closer to a social contract than what we see in Langata. The fact that the vendors provide water that they have diverted from the grid also lends some legitimacy to their water business, as it is not uncommon for residents to refer to water bought from vendors in Kibera as "water from Nairobi Water" or "city council water".

Obscurity and exploitation

The Kibera vendors' water provision system is still highly exploitative. Water is accessed on the vendors' terms and they are known – as some have even admitted informally – to create artificial scarcity in order to hike up the price.

The vendors keep the network intentionally complex so as to make it difficult for outsiders to trace their pipes, manipulate the network, or enter the market. Controlling the water flow requires navigating local power structures and maintaining a network of connections. I met several CBOs whose members were working to secure running water; their efforts were in vain, however, as they were caught between being unable to go around the organised water vendors in the area and not having the large sums of money asked of them to secure a connection from the vendors. In an April 2023 Kibera focus group, a frustrated woman who was part of a CBO that was unsuccessfully trying to install a water connection for their sanitation facility said that, "We are not getting water now. Not from the government, not from the cartels. They know how to get water, the community doesn't know".

While the obscure water provision system described above creates a lack of accountability and of opportunities for claiming water, there appears to be opposite dynamics in areas where the infrastructural network is more transparent and thus more available for people to engage with. According

to several residents, this is the case in Gatwekera, the Kibera village that borders the main pipe from which most of Kibera's water is sourced. As a female resident of Gatwekera explained in a March 2023 focus group, this area was the best in terms of water access in Kibera because, "In Gatwekera, you can't hike the price, so it's the safest place for water. People will cut your pipes if you hike the price". The fact that people were located closer to the source of the pipe seemed to give them more leverage to claim water. This is more difficult for people relying on water that is sourced from several kilometres away, where it is almost impossible to discern which pipes belong to which vendors.

Social embeddedness

Another crucial aspect of the water kiosk vendors' relationship with the people to whom they provide water is that vendors are part of the community and their position cannot be understood as something outside of it. One evening over dinner, a vendor named Boniface told me that I would never have to pay for anything when I came to his private home. "I don't have money, but I own the community. Even the government lives there. I know them" (Fieldnotes, March 2023). Boniface's claim that he did not have any money was only partly true, but it was something he would often mention in relation to the costs of keeping his pipe safe from vandalism, theft, and Nairobi Water's gaze. The physical location of the vendors' pipes and kiosks afford their embeddedness in the community by facilitating interactions between the vendors and the residents. One of the main strategies for mobilising social relations to keep their pipes safe is through financial incentives. In a February 2023 interview, a water vendor told me that, "80 % of getting started as a vendor it is being known. And you use money to become known. When people see you putting a pipe, they might say that they need money to provide for the security of the pipe". However, relations are also less transactional. Boniface would know anyone passing his water point on a main road in Kibera and he would sometimes keep an eye on kids going to school for the parents. This seemed to be a way to underline his influence and importance. He often referred to having government people as either neighbours or customers. Another vendor further down the road was paying school fees for the neighbours' children and was hiring local youth to watch out for his water point, a central hangout spot in the area. Paying for school fees and watching out for school children seemed to border on community charity and patronage. A common element of the interactions between vendors and residents is that they evolve around the infrastructural system; although they are often facilitated by the exchange of money, these interactions are a way for vendors to build a relationship with the community and establish their position. Literature from East African contexts, including Kenya, similarly shows the role of economic transactions in building social relationships (Kusimba, 2021; Mogensen, 2004).

An interview with Rita, a lifelong resident of Laini Saba in Kibera, highlighted the complex dynamics between consumers and water vendors. As a former assistant to a member of the county assembly and as a respected community health worker, Rita wields some influence over the vendors, many of whom she has known since childhood. She explained how these vendors, often sons of landlords or of former water vendors, operate as a tightly organised group with a leader, Kevin, who refers to Rita as 'mom'. As she said in a February 2023 interview, "They fear me somehow, so I have some kind of leverage. I will usually pull them aside privately and express my concerns. Then they might listen a bit". Rita has in this way occasionally curbed unfair price hikes, but her success depends on her presence and a careful mix of pressure and humour. They had recently dismissed her outright when she tried to confront them over selling dirty water and instituting excessive price hikes. Despite criticising the 'cartels', she still buys water from them, reflecting the ironic reliance on vendors as practical water providers.

Rita's relationship with Kevin and the other vendors shows their fluid position, balancing social intimacy and exploitation; it also highlights how actors shift between authoritative roles (Schwartz et al., 2015). As Truelove (2021) shows in her study of water authorities in an informal settlement in Delhi, water tanker drivers can simultaneously embody the subject position of the state and the 'water mafia'. Similarly, the water vendors of Kibera can place themselves in the role of ruthless businessmen, sons and

neighbours, as well as organisational entities acknowledging people's right to water. The relationship between Kibera residents and vendors is, in this way, more complicated than that between local authority and subject. There is not one form of the social contract; rather, there is a recognition of the services they provide, condemnation of their exploitation, subtle attempts to claim water or negotiate the terms, and even the option to cut the pipes.

The relationship between vendors and residents is also mediated by infrastructure, as we see in the way that above-ground pipes necessitate social engagements and how their location shapes people's ability to claim water. The systems are dynamic and manipulable. Pipes break and are replaced, and they are stolen by competing vendors or disconnected by Nairobi Water. These factors lead to daily changes in the network. During my time there, disconnections occurred about once a month but usually did not affect the most established vendors. A disconnection can quickly endanger the position of a vendor. It can also severely affect people's access to water, forcing them to pay higher prices, walk long distances, or use contaminated water. In this way, the systems are fluid in both material and analytical terms. Because the flow of water is easily physically altered, the position of vendors and their contracts with the community need to be constantly re-established. It also means that their position relies on being on good terms with the community; if they are not, people can obstruct their water pipes or refuse to watch out for them. The fragility of the water systems in Kibera thus only adds to the fluidity and volatility of the hydraulic social contracts.

FLUID AND FIXED RELATIONSHIPS OF AUTHORITY AND THE ROLE OF INFRASTRUCTURES

In this section, I argue that the moral economy around water claims – where contradictory relations dependent on social negotiation and are entangled with dynamic and obscure water systems – highlights the volatility of hydraulic social contracts. I then discuss how relations of authority are mediated by material infrastructures, which connects to the following subsection on how claims to water are conditioned and shaped by specific infrastructures.

A moral economy of water negotiations

Alba et al. (2019) show how the practices of water provision actors in Accra, Ghana, are shaped by relations of solidarity and a sense of responsibility, as well as by profit-making, political legitimacy, and patronage. The relations between the water actors and the recipients of water in Nairobi similarly reflect a moral economy (Olivier de Sardan, 1999) of exploitation and solidarity, particularly in Kibera where vendors are more embedded in the community. This urges us to look at the power and authority of such water actors as being more situational and dynamic than the traditional understandings suggested by Lund's social contracts of recognition (Lund, 2016). The social relations and contradictory logics that guide interactions between the residents of Langata and Kibera and their respective non-grid water service providers challenge clear distinctions between authority and subject, or provider and customer.

As Narain et al. (2023) also show in their study from Delhi, both piped and non-piped water access rely heavily on social negotiation. From a claim-making perspective, this urges us to look beyond the state when examining authority in water provision, even regarding state-regulated water services. This is evident in Langata, where grid valves are socially contested and where individual employees of the state-owned water company wield significant influence over water distribution.

Fluidity and stability of material infrastructures

While mistrust and opacity dominate interactions with water truck operators, the role of valves and Kibera vendors illustrates how infrastructure strengthens vendors' positions. Hommes et al. (2022) argue that hydraulic infrastructure arranges things and relations; they argue further that, although the infrastructure and the territorial relations it creates are always in transition, they are a particularly

powerful way to materialise and fix power relations in space and time (ibid). The fact that the vendors can sell the water, without treating it, after it has been diverted from the grid means that it can be quickly converted into cash and can thus strengthen the position of those who manage to gain control over it. The water, being a direct flow of money for the vendors, affords them the economic power to pay off both Nairobi Water officials and the police, thus permitting the continuation of their business. These range from small amounts – "for tea or lunch" – to larger sums such as the 7000 KES (US$54) loan that Boniface gave a Nairobi Water official to strengthen his relationship with the employee. The transactions are thus not fixed, rather they are part of the dynamic and continuous social interactions between the vendors and Nairobi Water employees. This economic power is fragile as it relies on maintaining pressurised pipes that can be stolen, vandalised or disconnected. Vendors who neglect their pipes risk losing their business.

To secure their operations, vendors can link pipes to larger and more stable infrastructure projects in the city. Vendors can, for example, pay off workers who are doing railway and road work or laying internet cables to secure their pipes by laying them deeper down in the ground. One vendor, Peter, told me a story about how he and his helpers would pay off some of the workers of a Chinese company laying sewer lines and how, even though the police were overseeing the job, they got confused about who was working for the company and who was not. This meant that Peter and his helpers could put a pipe down right in front of the eyes of the police. Peter explained that getting a pipe this deep in the ground secures it for many years if there is no big construction project around it, which is the only thing that might destroy it. Infrastructure is a central way to stabilise relations and secure the steady flow of water and revenue.

Affordance for claims

Just as infrastructure shapes the water providers' ability to control and exploit water, different infrastructures create different conditions under which people are able to make claims to resources. Timothy Mitchell (2009) provides an example of this in his book entitled *Carbon Democracy*, which describes how oil pipelines reduced the ability of humans to interrupt the flow of energy. With coal production, coal workers had the political capacity to stop or slow production to demand more democratic rights; pipelines, on the other hand, allowed the political capacity of the energy resource and its distribution to be in the hands of a few actors and to be controlled on a national level (ibid). In Nairobi, similarly, we see how different infrastructural systems and conditions afford different opportunities for residents to engage with the actors who are in control of the water and claim water services from them. As mentioned above, the residents of the village of Gatwekera seem to be able to demand greater accountability as they are close to the source of the pipes and have the opportunity to cut them open to receive water if the price is raised. The residents in Langata, in contrast, struggle to determine who controls the water and on what basis; because valves are turned on and off at night, it is unclear who to turn to for improved water access. Similarly, there was Sylvester, who had little space to manoeuvre in terms of improving his water supply because his landlady would not show him the valve. On the other hand, the fact that the vendors and their water kiosks in Kibera are a more integrated part of the community gives residents more space for negotiating with them. I cited Rita as an example of this, who claimed to at times be able to negotiate with the vendors by using the right mix of intimidation and humour.

Different infrastructures thus present different conditions for how to engage with water providers; they also shape how claims can be made on water and the various opportunities available to vendors for establishing control over the water. In both Langata and Kibera, however, infrastructures are fragile and socially embedded, and it is difficult for both providers and recipients of water to establish a consistent flow. The fluidity of the water and the infrastructures providing it tie into dynamic relations between tankers, Nairobi Water employees, Kibera vendors, and the residents of Kibera and Langata.

CONCLUDING REMARKS

This study reveals a dynamic relationship between water, infrastructures and social relationships, and it demonstrates how that relationship creates hydraulic social contracts of social embeddedness and exploitation. Highlighting the fragile and evolving social contracts that shape water provision in Nairobi, the paper urges a dynamic understanding of authority, framing it against the concept of 'hydraulic social contracts'.

The paper contributes to two fields of study. The first of these is the rich body of literature on heterogeneous water provision which, except for Truelove (2019, 2021), has focused little on these infrastructural systems and water actors from an authority perspective. By showing how relations between water vendors and residents are built on both intimate social relations and exploitation, the paper aligns with the findings of Alba et al., (2019) from Accra, which show how many seemingly contradictory relations shape the practices of water actors. The second field of study to which the paper contributes is that of the constitution of authority through claims to water resources which, from the perspective of social contracts, has till now focused primarily on claims to land (Lund, 2016; Setyowati, 2020; Titeca et al., 2020).

In line with Anand (2017: 12), who highlights how water infrastructures, "reveal how our material, imaginative, discursive and legal worlds are held together through unstable relations", this paper highlights the need for situational and dynamic understandings of authority that allow for contradiction. This is particularly important in the context of authority and claim-making around fluid resources that are dependent on infrastructural systems. This paper highlights the fragility of 'hydraulic social contracts' and takes the connection between social and political structures and material infrastructures a step further than does Anand, as it points to how the materiality of resources matters to the forms of everyday political structures emerging around them.

I have followed Smiley (2020) in taking the heterogeneity of water supply infrastructure as a starting point for understanding everyday urban water politics and the socio-spatial inequalities in water distribution. My study of water provision systems in Nairobi, however, reveals how engagement with different infrastructures in spatially different areas of the city creates particular socio-spatial inequalities between water service providers and residents. Each of the infrastructural systems presents distinct challenges and ways to claim water. The water trucks, as infrastructure, establish little connection between water users and water providers; relationships are between one individual and another and are based on loyalty and trust. Their context is dominated by suspicion and mistrust, however, and these relationships are thus under considerable pressure. Interactions around the valves that determine the flow of water in the grid, for example, are shrouded in opacity and suspicion. In Kibera, as described above, water vendors and their piped networks and water kiosks are the dominant modes of water provision. It is thus easier to see the emergence of relations of authority between vendors and water buyers, because residents more readily recognise the vendors' role in the water provision system and have slightly more room to manoeuvre in terms of making claims to water. The relationships between water vendors and water users, however, do not resemble the more stable relationship between public authority and the subject that Lund (2016) describes as a social contract; instead, they reflect the dynamic qualities of the water and of the pipes it flows through and of the moral economy (Olivier de Sardan, 1999) in which they are embedded. Water entrepreneurs, in this environment, simultaneously take on the contradictory roles of water patron, good neighbour, and cartel member. The social contract concept highlights how we need to acknowledge the importance of relations that arise out of the dynamics of service provision. Examining the concept of social contracts through claims to hydraulic resources, however, destabilises it. It does so by revealing relations of authority that are largely dependent on the transient and unstable nature of both the material of the resource (water) and the infrastructures mediating it. It is thus water's fluidity that underpins the entanglement of materiality and authority.

ACKNOWLEDGEMENTS

I want to thank everyone in Nairobi who has contributed to this study for their time and the way they have shared their everyday lives. I would also like to thank Michael Eilenberg, Mattias Borg Rasmussen, and Jacob Rasmussen for their feedback and productive discussions on how to develop this article further. I also want to thank the three reviewers and editors for their thorough and constructive comments. All shortcomings are my responsibility

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