Making the water flow: Conflict(s) and cooperation between formal and informal urban water regimes in Africa and Asia

The Cases of Mathare and Kayole-Soweto in Nairobi, Kenya

Report produced for KTH Royal Institute of Technology as part of the study financed by Formas Future Research Leaders project grant titled ´Making the water flow: Conflict(s) and cooperation between formal and informal urban water regimes in Africa and Asia´.

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Date: 03th June, 2020

Executive Summary

A majority of residents of the low-income settlements in Nairobi face numerous challenges related to the provision of water and sanitation services. Access to water is largely characterized by informality as the very nature of the settlements impedes the ability to formalize water provision channels. Informalities in water provision arise from but not limited to water diversions (illegal connection from the main utility grid), supply of water using trucks, carts, and boreholes. By and large, informal water is viewed as a commodity for business venture and hence a source of income to the actors involved. As a way of minimizing informality and non-revenue water (NRW), the Nairobi City Water and Sewerage Company (NCWSC) piloted two formal approaches/technologies that would potentially increase access to water at affordable prices in Mathare and Kayole-Soweto, low-income settlements of Nairobi. The two technologies are the Pre-Paid Water Dispensors (PPD) and *Jisomee Mita* (JM) in Mathere and Kayole Soweto respectively. These technologies have different structural and functional domains and pose different advantages and/or disadvantages to different users and water vendors. The current study independently explores water-related conflicts and cooperation experienced in the context of these technologies vis a vis the informal water providers.

List of acronyms

CBOs	Community Based Organizations
CHW	Community Health Worker
ISD	Informal Settlements Department
ISR	Informal Settlements Region
JM	*Jisomee Mita*
KNBS	Kenya National Bureau of Statistics
KRs	Key Respondents
KTH	Royal Institute of Technology
LIAs	Low Income Areas
NCWSC	Nairobi City Water and Sewerage Company
NGOs	Non-Governmental Organizations
NRW	Non-Revenue Water
PPDs	Pre-Paid Dispensers
SDGs	Sustainable Development Goals
TU-K	Technical University of Kenya
WASREB	Water Service Regulatory Board
WSS	Water and Sanitation Services
WSTF	Water Sector Trust Fund

1. Introduction

Access to clean and adequate water in Kenya is a basic human right guranteed by article 43 (d) of the constitution of Kenya (2010) and article 9 of the water act (2016). For a long time, low-income settlements in many urban areas of Kenya, especially in the capital city - Nairobi, have not had a formal water connection, and instead, water supply and sanitation services have been largely characterized by varied informalities such as supply of water using tanker tracks, carts as well as illegal water diversions of water from the main grid. Community and private boreholes are also randomly sunk to supplement existing insufficient water sources.

Residents in the low-icome settlements of Nairobi face numerous challenges such as economic poverty, high rates of unemployment, insecurity and poor Water and Sanitation Services (WSS). These problems are further complicated by social, cultural, economic and political dynamics which largely limit sufficient supply of water through formal means. It is arguably on the basis of such complexities that the Nairobi City Water and Sewearge Company (NCWSC) decided to pay special attention to the water needs of the low-income settlements by establishing the Informal Settlements Department (ISD) in 2009 that aimed at promoting WSS in Low Income Areas (LIAs) as well as minimizing Non-Revenue Water (NRW). In 2015, the ISD transited to the Informal Settlements Region (ISR) as a full commercial entity with associated commercial, technical and social responsibilities for water service provision to LIAs. With these structural changes, it was hoped that NCWSC would then adequately address and formalize matters WSS to the low-income communities in Nairobi.

It is against this backdrop that in April 2014 and November 2015, NCWSC through funding from the World Bank initiated two innovative projects, *Jisomee Mita (JM)* and *PrePaid Water Dispensers (PPD)* in Kayole-Soweto and Mathare informal settlements respectively. The two technologies sought to empower the urban poor in a number of ways (such as but not limited to economic empowerment through water price regulation, ability to pay for water consumed at any time of convenience, minimization of wastage of time occasioned by trekking for long distance looking for water etc.).

In spite of these technological and innovative advances, the urban poor in Nairobi's low-income settlements still resort to informal modes of water provision to meet their water and

sanitation needs. The most common informal sources of water include supply by the cart pushers from one point to another (depending on the level of demand), use of water trucks, water acquisition from community and private boreholes, water diversion from the formal piped systems, and use of donkeys. These modes of water provision have often contravened the formal interventions by the NCWSC and have hence created challenges that are multi-dimensional in the context of formal and informal overlapping technologies and sources of water. The current study explores how water conflicts emanate from these drivers and the mode of cooperation adopted to mitigate potential adverse levels of conflicts.

2. Case Study Sites

2.1 Case study 1: Mathare

Mathare is one of Nairobi's low-income settlements located approximately 3 Km from Nairobi's Central Business District (Berkeley et al., 2009) and with a population of about 206,564 (KNBS, 2019). Other sources suggest that the population of Mathare could be way above 0.5 million people (Priscilla, 2017). The settlement covers a surface area of about 73 hectares of land (WSTF, 2010) and it is bordered by two main highways, Juja Road and Thika Road. Much of the Mathare settlement was formerly a quarry and some settlements are built on steep slopes of carved-out rock. The settlement is routed by Mathare and Gitathuru rivers which form part of the larger Nairobi River Basin. Figure 1 shows the map of the Mathare informal settlement with its villages. Synonymous with most low income settlements in Nairobi, Mathare is characterized by insecurity, inadequate access to water and sanitation services and other social amenities as well as unresolved issues of land tenure.

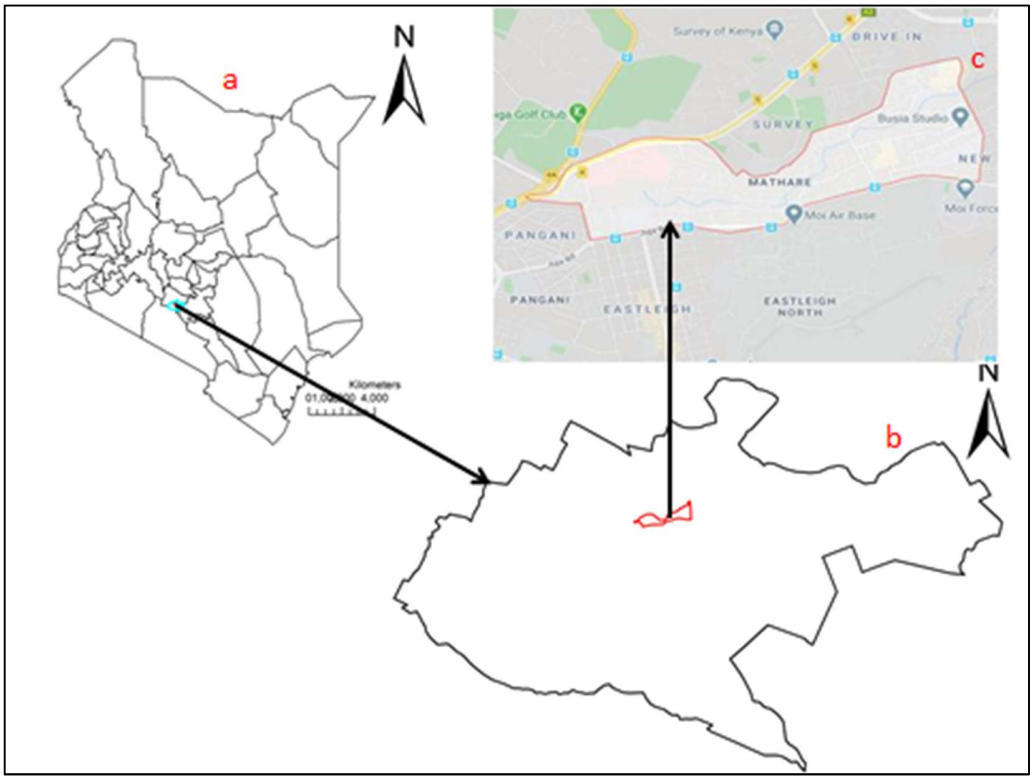

Figure 1: Map of Kenya (a), Nairobi County (b) and geographical extent of Mathare Low-income settlement (c) (Google maps, 2020)

2.2. Case Study 2: Kayole-Soweto

Kayole-Soweto is a low-income settlement located in Embakasi sub-county in Nairobi City County. The settlement has nine local administrative zones i.e. Muoroto, Bahati, Shauri Yako, Kibagare, Muthaiga, Central, Gitau, Muungano and Patanisho, established on a parcel of land of about 8 hectares (Kambua, 2018). According to the to the NCWSC (2013), Kayole-Soweto has a population of about 90,000 people distributed in 22,400 households. Most of the residents of Kayole-Soweto are unemployed and work as casual laborers in different sectors (Kambua, 2018). Figure 2 shows the geographical location of the settlement with the defining zone.

Figure 2: Kayole-Soweto settlement (Kambua, 2018).

3 Research question and objectives

The case study analyses and develops empirical data for answering the research question

How does the interaction of formal and informal water regimes produce different forms of conflict and cooperation?

The question is answered by the following three sub-activities

1. First, the report describes information collected in support of understanding the formal water regime

2. Secondly, the report documents the understanding of the informal water regime

3. Thirdly, the report analyses how the two regimes interact in terms of producing different forms of conflict and cooperation.

4 Methodology

The data for this study was collected through fieldwork observations and interviews conducted in the two study sites during November-December, 2019. Fieldwork and face-to-face semi-structured interviews using previously established lead questions and follow-up questions was the main method, see also Appendix 4 for the questions. Key Respondents (KRs) interviewed included local water users and water vendors (including community-based organizations (CBOs), youth and women groups, individual water vendors e.g. borehole owners, water cart pushers and water tanker drivers). KRs also included key stakeholders in WSS - largely representatives from NCWSC.

A total of 23 KRs were interviewed (11 being local water users and vendors where PPDs operate in Mathare, 9 local water users and vendors from Kayole-Soweto where JM technology is implemented, 3 were representatives from NCWSC who shared the cross-cutting and broader

perspectives of conflict and cooperation from the two cases. The information provided was recorded using a smartphone and subsequently transcribed. The quotes that inferred to existence of conflict and/or cooperation was captured to formulate answers to the research question.

5 Results for the case study

5.1 Results for Case Study 1 - Mathare

5.1.1 Formal Water Regime – The role of the PPDs

In Mathare, the formal water regime is defined by the pre-paid water dispensers (PPDs) which are installed by the NWSC. The water in the PPD tanks is supplied to the tanks by NCWSC operated trucks once every week, see also Figure 3. In installing the PPD infrastructure, a number of challenges are often experienced by the service provider. According to a senior official from NCWSC (KR21) there are always high levels of resistance against implementation of any new water supply technology in the informal settlements ***("…Any time you move to a new region with the intention of establishing water infrastructure, there is always that conflict between illegal providers and formal water supply….There is this resistance by the people who have made water as a commodity for sell, so you can imagine somebody feeling that a decision to implement a project is aimed at cutting off his source of income,…so they will do anything to stop you including being violent against you").*** We noted that since the informal settlements did not have formal water supply and had for a long time been managed by illegal water vendors, establishing a technology by the service provider was always viewed as a threat. A social worker 'sociologist' at the NCWSC offices in Mathare (KR23) informed us ***("……At the beginning when we started installing PPD dispensers, we were challenging the existing system which was exploitative….we faced a lot of challenges")***.

Figure 3: Modes of formal water supply in Mathare: The example of the PPD water kiosk

In the current context, the PPD dispensers do not assure adequate access to water by the residents of Mathare and in day to day operation suffer from numerous challenges. A community social worker (KR2) suggested that the water supplied is generally regarded as dirty (***"…..The kind of water that was delivered yesterday was so dirty that nobody could drink it")***. Furthermore, according to KR21, vandalism and theft of the PPDs is regularly reported in Mathare ***("….Even where we have managed to penetrate and put our services there, there still is a very high risk for vandalism")***. Another challenge is that generally there are insufficient PPDs in the settlements. The rate of installation of PPD has been generally slow partly due to lack of public land and also lack of incentive within Mathare to take up the running of a PPD.

Access to the PPDs by the community is based on a token system, see also Figure 4. Water users can apply for a token using a simple application form to the water company. The water supplied to the informal settlements is heavily subsidized and therefore in theory the cost of water using tokens should be low. However, considering that Mathare is a highly populous informal settlement, the number of tokens issued for the PPDs is insufficient. There is also poor awareness about the actual functioning of the token system. This creates scope for intermediaries

(middle men) that can inflate the price of the water by controlling access to the tokens. These intermediaries that control the tokens may or may not be the same individuals that operate the PPDs.

One interaction with a local water vendor and token holder (KR1) for instance confirmed that due to the scarcity of tokens people without tokens tend to pay much more for the 'formal' water at an inflated price. (***"….I charge Ksh. 5 because one bob cannot buy anything in this area, so by selling at 5 bob, I can buy some stuff,…….water is sold at 5 bob everywhere in this area, so if one does not have a card, he buys water at 5 bob,….The advantage of this card is that one makes a lot of profit when selling water with it").*** People are therefore willing to accept to spend Ksh. 5 as opposed to Ksh. 0.5 (that is the formally set price by the water company). The generally insufficiency of the PPDs to supply water to the settlement creates a gap that is met by the informal regime.

Figure 2: Sample of PPD token

5.1.2 Informal water regime

The informal water regime in Mathare includes a plethora of illegal water connections within the entire settlement that are not mapped out by the NCWSC (namely, illegal connections to the main water grid), water supply using carts and tank trucks, see also Figure 5-6. According to a water official from NCWSC (KR21), the motivation that drives people to choose water coming from illegal points is that PPDs are far from where people live ***("….Why people would go for water from illegal vendors is when our services are far ")***. This is another way of explaining the generally inadequacy of the formal regime to cover the whole settlement.

Figure 5: Illegal water connection in the Mathare settlement.

Some water users, like KR8, who actually also owns a PPD token card, uses water from the PPD kiosk for washing clothes but not for drinking. Drinking water was obtained using illegal water connections. (***"…….We use all these sources of water. Water from PPD is cheap and I use it for washing clothes but I use this other one for drinking. ……Someone can throw dirty things in the PPD tank and sometime it is not clean, so we don't drink it. We trust this other one more, even though the pipes pass through sewage, we prefer it because it is***

running water"). It was reported by this particular water user that as long as there is water available at various informal water points, little attention is paid to the PPDs (***"……Most of the time we don't put in mind the availability of PPDs. We only think about it when we don't have water here….Even though the PPD water is far cheaper, we don't mind paying for 5 bob for this other one")***.

Figure 6: Water supplied by water carts

It was alluded that the existence of water cartels is largely behind many of the informal water connections. The social worker (KR 2) which was introduced earlier mentioned that (***"…….what is in your pocket will make you connect water……..some of the staff from Nairobi water help people in connecting water and when I raised a complaint, I was told that the people who had connected water had paid for it. It made me think that I was wrong to complain and that I was responsible for the problems affecting water provision").*** It was reported that for someone to illegally connect water, a fee of Ksh. 15,000 is paid to some individuals in NCWSC, after which the cost of piping and labor involved is covered by the "water applicant".

A number of informal water networks operate in the area often referred to as 'youth groups' even though the ages of the members can vary considerably. During times of water shortage in Mathare, these youth groups become particularly active and supply water from

neighboring districts using carts. According to one cart pusher (KR6), who belongs to Mathare Mashimoni Youth Group, water can be acquired from Pangani at Ksh. 5 and then sold in Mathare for Ksh. 25 thereby making a profit of 500%. (***"…..Many people prefer the water that we supply as opposed to the one form the PPDs as many do not have token cards").***

Another form of informal regime is when a licensed metered water vendor (KR11) uses this license to sell water at an inflated cost. KR11 has established his customer base, a majority of whom are water cart pushers from Huruma; a neighbouring area and sells water to them at Ksh. 2. However, for local people who buy water for consumption, water is sold to them at Ksh. 3 (***"….I sell water at between 2 and 3bob….2 bob applies to cart pushers who re-sell it but 3 bob applies to local people but 5bob when water is too scarce").*** This is another form of price inflation which also suggests a form of cooperation between different informal service providers ensuring that other informal water providers business interests are taken care of.

5.2 Results for Case Study 2 - Kayole-Soweto

5.2.1 Formal Water Regime – Jisomee Mita

In Kayole-Soweto, the formal water regime is primarily enacted through the use of *Jisomee Mita* (JM) in respective residential apartments, see also Figure 7. This is essentially a water meter system introduced by the NCWSC during May 2014 to address water challenges in low income settlements. The designed water system *Jisomee Mita,* is based on hybrid technological constellation which combines ICT tools with an expansion of a network of water pipes (Guma and Schramm, 2019). The technology serves as a channel for accessing water and at the same time allowing linear interaction between water users and service provider through self-meter reading and billing (NCWSC, 2013).

Our interaction with a resident of Kayole-Soweto (KR12), found out that water supplied via the JM is roughly once a week on Wednesdays using the JM. (***"…..We receive water once a week, on Wednesdays only and store a lot to sustain us on the days we don't have water")***. Another caretaker of a residential flat which host 30 families (KR13) also informed us that the water supplied through the JM was generally not enough for all the families in the flat (***"….The water supplied is not enough for all of us, we are 30 families. Sometime this water passes***

through sewer and gets contaminated….I was treated early this year because of cholera after I consumed this water. ….So it is required of us to treat this it before drinking it").

Ability of water users to read the JM meter and interpret the water consumption and pay the bills was a problem, thereby prompting the utility to rely on its staff to do so. But this situation can also prompt instances that a water connection is discontinued. In addition, the landlords tends not live in the same place together with the tenants who are the primary consumers of the water supplied. Should there be a water disconnection due to non-payment (which might be because of failure to read a water meter), it is the tenants who are affected (KR21). According to the senior engineer of the NCWSC KR22, vandalism of the JM has also been reported to occur many times ***("…Yes, so many times, the JM has been vandalized…I repaired a section where someone inserted a wooden piece in the pipe and affected the whole of that line such that people never received water for three years").***

Figure 3: Examples of Jisomee Mita in an assembled state (a) and removable state (b)

5.2.2 Informal Water Regime

The informal water regime in Kayole-Soweto is complex and involves numerous actors including the use of hand-held carts, trucks and water from boreholes owned by private individuals or community organisations such as local churches. The informal regime generally

complements the formal one and is considered vital to bridge the demand and supply gap even if it often incurs a higher cost to the water users (***"….Whenever I don't have water and I need to wash clothes, I call cart pushers who supply water to me at 15 to 20 bob", apartment caretaker, KR13).***

We were informed that cart pushers had their areas of operation and cannot allow other people to sell water in other territories**.** KR16 who vends water on a cart mentioned that normally each person has a customer base and clients always call their own water suppliers (***"….Once you form a customer base, the customer cannot source water from other suppliers").*** This however requires that the supplier is readily available whenever water is required, else, the client can opt for another supplier if any delays happen. Another cart water vendor, KR19, informed us that he had sold water for more than ten years. On a day, he is able to sell sixty 20L containers at Ksh. 20 (making approximately Ksh. 1200 a day). (***"….I have my specific place where I do report to sell water daily. I always sell from that point near catholic church…….Although we are many people in this business, we don't fight when I find someone else there because my business does not affect his as we all have our own established customers who call for water").***

We also noted that most of the carts had inscription of mobile phone numbers of the cart pushers. This had made the work easy as customers would make direct calls for water and the supply of water is targeted. This minimizes loss of time and energy as well as motivating water vendors who feel that their services are good and satisfying to the extent that clients called for water ***("…Even when I am far, my customers will just call and I have to take water to them", KR 19, cart water vendor).*** We also found that if a water vendor gets some problem, the other vendors help him in overcoming such problems through financial aid ***("….When one of us gets a problem, we help him to overcome it by contributing some money to him. The problems we assist to overcome include contributing money to buy a cart if someone loses a cart, or contributing money to help meet hospital bill if one of us or a family member of one of us is sick and needs to be treated in the hospital" KR 19, cart water vendor)***.

Turning to the water abstraction through boreholes. We visited a community borehole operated by Soweto Catholic church where we interviewed a Catholic Lay Brother (KR18). Unlike the other boreholes which sell water Ksh. 3, water at Soweto catholic church borehole is

sold at Ksh. 2 as a way of easing economic burden to the less fortunate in the society ***("KR18_00:20-00:35….This being a church borehole, we sell water at 2 bob a container so as to help less fortunate people and those that do not have sufficient income. We don't hike our prices").*** We noted that this is a way of cooperation which the church uses to alleviate economic poverty. The collected money is managed by the church. There was a reported form of conflict between the church managed borehole and the Nairobi city county officials ***(…We have been disrupted several times by people from the city council….They think that as a catholic church we have a lot of money and hence they always come to disrupt our water with threats of closing the borehole unless we bribe them…I have called the Governor to complain on the same and he has informed us to alert him when the same officials come again, he promised to take action on them…..We have all the required documentations including contract to operate a borehole but they still come to disrupt us. When you go to other boreholes, you will notice that they don't have the right documentation to operate the borehole……It is very unfair for us to be treated with discrimination……Sometimes you may get different people coming on different days or different times on the same day asking for bribe in order for us to operate, they especially think that as a church we get sponsors who support us).***

We noted that the above statements allude to the politics of water which are at play regarding the permission to operate boreholes. There was a lot of resistance within the settlement when the utility was in the process of acquiring right of control of the borehole ***("…oooh! It was murky my brother, it was not easy. This is like you are pulling bread from somebody's mouth…….We tried to investigate who was benefitting from that money but we couldn't reach the bottom of it, we were silenced along the way")***.

Electricity consumption for pumping water from the borehole is alluded as the most expensive aspect of running a borehole. We noted that pumping water using electricity was very expensive and according to the responded from the church, KR18, it costs between 550-600 USD (Ksh. 55,000 to 60,000) a month ***(…..It is very expensive to pump water using electricity. That borehole over there in the offices of Nairobi water has been closed down for some time now because they could not pay for electricity and sometime they used illegal electricity connection)***. We were also informed that by selling water at Ksh. 2, the church was able to

generate about Ksh. 135,000 to Ksh. 145,000 (1350-1450 USD) per month from which electricity is paid as well as some salaries of a few people.

6. Understanding the key modes of conflict and cooperation in the two Mathare and Kayole-Soweto

In this section we highlight key modes of conflict and cooperation in the two study sites. Turning to Mathare first. There are instances narrated to us in which conflicts over water escalate into physical fights (***"…..People fight here over water sometimes, whether water is in abundance or not. When you come here, you will be surprised at the kind of water related fights…..The fights occur for example when someone goes with many containers and insists on filling all of them with water before allowing others, even with one container to draw water", KR 8, water user, resident)***. It was suggested that one way of resolving such conflicts would be for NCWSC to increase the water points and especially close to where people live (***"……For this conflict to end, people should be supplied with water to their doorsteps", KR8)***. Direct and indirect forms of conflicts were reported. For instance, it was reported that some water vendors end up blocking water destined to other points in their favour (***"…...Even if people don't fight over water, there is indirect conflict where someone blocks access to water so that we can buy from them, since they say that it is their source of income")***.

In Mathare, political influence was cited as one of the deeper causes underpinning conflicts for water. Some wards such as Mlango Kubwa and Kiamaiko hardly experienced water scarcity compared to Hosptital, Huruma, Mabatini and Ngei wards which experienced severe water shortages. According to a community health worker, KR3, that we interviewed (***"……..There is no day water will lack in Mlango Kubwa ward and Kiamaiko ward, but when it comes to these other four wards; Hospital, Huruma, Mabatini and Ngei wards, there is severe rationing of water…if you inquire more on the reason for water shortage, you will find so many stories. There are people who are beneficiaries of this shortage in these three wards….Like yesterday, we threatened the government to supply water or else we demonstrate, that is when they supplied water. Had we not issued threats, you would have seen our women passing here carrying water from other villages").***

It was noted that water is supplied with significant levels of political discrimination that can potentially lead to conflict and violence, especially if people get aggrieved and feel discriminated against, especially from a political point of view. The same community health worker from Mathare reflects (***"……Those wards that I have mentioned as being water sufficient, correspond to the ruling party and others are leaning to the opposition")***. The same was reported by KR23 where politicians use water to gain political mileage (***"…..Water is very political, you cannot separate water from politics for the very reason that water business is very lucrative……To reduce the level of political disagreement, we have to work with the local leadership and political class…….Yes, they complain of water scarcity. There are areas that receive water every day but others four times a week").***

We noted that water shortages can be a very common source of conflict in Mathare. KR23 informed us (***"…Whenever we have election, we experience lot of disruption in water…Youth use politician to hike water prices"***). It was alleged that the beneficiaries of the water shortage is a complex actor network, including water cartels but also those in the political leadership. (***"……We suspect even ward administrators benefit from the shortage, you can call him to address the water shortage and he tells you that he will consult…, consult from who for two weeks…..if this the shortage persists for three weeks, we block the road?", KR 3, community health worker)***. Inter-group conflicts can also create water shortages when youths from one group block water lines for other groups so that they get more customers for buying water (***"……some youth are paid by water cartels to block the lines of other youth groups so that they can sell… when they sell and other youth fail to sell water, the affected youth group attack the ones who blocked their water lines, causing injuries and sometimes death, like it happened recently.", KR 3, community health worker)***. (***"……The water cartel is a system, not just a simple system but the one that also involves government officials……For example there is a person next to this village, there is a time you will find he has water when the whole village has no water…..until threats are issued shall you see water flowing ", KR 3, community health worker).***

Conflicts of interest that do not escalate into larger conflicts are also visible particularly at the point of water collection, the PPDs. According to a water vendor and businessman (KR5) from Mathare who belongs to a self-help group, when someone goes to draw water and doesn't

have a token, he/she is assisted by him to draw water using his token at Ksh. 5. He also owns a shop tag-a card voucher that can be used to recharge tokens. (***"……Many people in this village use tokens, only a few don't, and especially the aged. ….If I top up my shoptag with even Ksh. 4000, it will be exhausted within a day…..For every Ksh. 1000 topped up, I get a commission of Ksh. 400, the money which benefits the group").*** The fact that there is no direct mode of recharging the tokens using mobile phone platform, leaves a loop hole for possible exploitation of water users without tokens, thus perpetuating a conflict of interest. Shoptag holders get 40 % income through the shop tags while at the same time denying users without tokens to top up the cards by themselves.

Turning to the conflicts in Kayole-Soweto. An important source of conflict that is particular to the case of Kayole-Soweto is the precarious relationship between the tenants of the apartments and the landlords. This was explained as such ***("…..I started living here eight years ago. When I came here, rent was Ksh. 2000 but after this water meter (JM) was installed, the landlord increased rent to Ksh. 2500 per month, a figure which incorporates the water bill. Besides that, we pay for our electricity by ourselves", apartment caretaker, KR13)***. In this case, we can see that the conflict starts with the fact that the landlord has significant leverage as a 'middleman' between the NCWSC and the tenants.

A senior engineer of NCWSC (KR22) at the Kayole-Soweto offices, mentioned that in some instances because of the landlord water was not supplied to the tenants, but still they were paying rent, which included cost for water for three years even though the water was undelivered. ***("….Some of the things we are not keen about is the arrangement between the tenants and the landlord….We only know the landlord who signed the contract……We have had cases where tenants have come here to complain that the landlord was denying them water in spite water being around").***

There were also cases in which the landlords failed to remit water bills to the utility which resulted to water disconnection. While this can be seen as a conflict between the landlord and the water utility. It is important to note that in the process the tenants suffered more significantly and raised some complaints to the water utility (***"…….People do complain a lot when they don't get water yet they paid to the landlord while at the same our neighbours have***

water. Sometime it gets worse to a level where they resist paying rent. They say there is no way we will pay and we don't get water", KR22, water official).

We were informed that in Kayole-Soweto there were also conflicts around the boreholes. This was partly because water users who bought water for private use paid Ksh. 3 while those buying water to sell on the carts buy water at Ksh. ***2 ("…..It is unfair to buy water at 3bob and some people are sold at 2bob", KR 17,*** resident lives in an apartment of eight families***)***. Another form of conflict around the boreholes was noticed when water prices go up on Sundays (because demand is higher) in which case water is sold at Ksh. 5 instead of Ksh. 3 as normal (KR17).

In a general context of conflict over water, we observed interesting examples of cooperation in both Mathare and Kayole-Soweto. Particularly within the informal regime there are interesting examples of cooperation. Looking for instance at the youth groups supplying water using tanks and carts in Mathare, it was reported that not all youth group members can turn out every day to sell water, and hence members sell water on rotational basis and should at the end of the day submit Ksh. 300 to the youth group without fail (***"…….The group has set a target of Ksh. 300 to be submitted to it every day, any money I make above this is mine…..It is a must for whoever on duty to submit this money", KR 6 cart pusher and water vendor)***. This is a kind of cooperation within the group that enables members of the group to benefit as long as the group remittance target is achieved. For instance, if a cart puller carries 32 containers for which each is sold at 25, it means that for one round of water supply, a member on duty can raise Ksh. 800, from which Ksh. 300 is submitted to the group and the remaining Ksh. 500 is taken as profit by the person on duty. On a good day, someone can sell six carts of water containers, making Ksh. 4500 after group deductions.

We interviewed a member of Mathare Progressive Youth group (KR9), which had been in existence for 7 years and with membership of 20 people. This group gets water from the main grid of NCWSC but does not sell the water. Instead, the water obtained is used for free while offering other services such as people taking a bath and using the toilet (both of which service paces are provided by the group***). ("……We don't sell water, instead water is used by people to take bathe and flash the toilet. For one to take a bathe, we charge Ksh. 10 and for one to use in flash the toilet, we charge Ksh. 5……We decided not to sell water so as to minimize any***

possible conflicts"). The group is organized such that no money is lost and whoever manages the business earns a salary and ensures all items required such as toilet papers and soaps are bought. In a day, a net amount of between Ksh. 300 to Ksh. 1000 is deposited in the group account, and shared out at the end of every year.

Our interview with another representative of Shanti Youth Group (KR10) in Mathare raised also an interesting kind of cooperation. The group attracts membership of people as young as 12 years and as old as 42 years and is not restricted to maximum number of membership. The water of the group is in reality illegally connected from the NCWSC main grid located along the main highway. The water is sold as drinking water at Ksh. 3 for 20L containers. The income generated is used to sponsor sports for the young people aged 12 belonging to the group and nurturing their sports talents. During water scarcity periods when they have water, it is sold to cart pushers at Ksh. 2 for 20L by virtue of cart pushers having many containers and draw a lot of water at once (***"…When other people have no water we assist them by selling water to them. For cart pushers who have many containers, we sell to them at 2 bob instead of 3 bob ….. …we sponsor sports for the 12 year olds by buying food to them and facilitating their games").***

In Kayole—Soweto, we observed interesting forms of cooperation within the apartments. One of the apartment residents in Kayole-Soweto, KR17, lives in an apartment of eight families. Even though water is supplied once in a week via the JM meter, this water is shared almost equally through an established arrangement of one person filling a container and letting another do so on rotation ***("….When water comes, each person is allowed to fill one container each round until the water runs out").*** This is a form of cooperation within the apartment and for the families that ensures equitable distribution of the available water. Forms of cooperation were noticed also between tenants and informal water vendors. For instance, KR15, an apartment resident would assist in selling water on behalf of someone else (***"…….When he (water vendor) is not around, I can assist him in selling water and then I hand the money to him when he comes back").***

6 Conclusion

This study focused on identifying sources of potential conflict and cooperation related to water service provision in Mathare and Kayole-Soweto, two informal settlements of Nairobi-Kenya.

The study found that conflicts occur all the time–and to some extent, escalate to violence. An important reason for the conflicts was the variability of water pricing which was mostly triggered by water rationing and the inability of the formal regime to supply sufficient water. Water rationing, such as between different wards in Mathare, was found also to be a particularly important trigger of conflicts which quickly lead to complaints directed to the service providers and the local political leadership.

We were surprised to see however how local communities of water users tended to adjust to a very dynamic situation of price fluctuations and precariarity of water supply through multiple regimes (see also Appendix 1). Mechanisms of cooperation which are constantly re-negotiated make this possible (see also Appendix 2). Forms of cooperation have included the tendency of local communities to adjust to water prices set by the main water vendors and buying at the set prices. This can however also be interpreted as a conflict of interest that is not in the favour of the water users. Furthermore, the water utility itself has decided in some instances to enter into some form of cooperation with informal networks such as youth groups (operators of the PPDs) and tenants and landlords (operators of the JM) to ensure a mutual interest for the water users and the water utility, in other words, to keep the 'water flow' against all odds.

Overall, it was found that the establishment of the two formal regimes, the PPDs and JM technologies in Mathare and Kayole-Soweto respectively, have not provided yet a significant solution to the drinking water supply problem of these settlements. This is partly because of a failure of the water utility to see beyond and address complexities in the settlements such as problems occasioned by lack of clear land tenure systems, high level of youth unemployment, and political dynamism. It is because of this reason that the two technologies are surrounded by several models of informal water supply regimes. The informal regimes, despite their problems are in this context necessary. These different regimes do co-exist because of the necessity of water supply, however this comes at cost for the water users.

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Appendices

Appendix 1: Key models of drinking water supply

Water regimes	Model 1 - Water supply		Model 2 - Water supply	
	Formal regime	**Informal regime**	**Formal regime**	**Informal regime**
Actors	NCWSC	Individuals, Youth Groups, Women Groups	NCWSC	Individuals, Youth Groups, Women Groups
Technology	PPD	Water Diversion and selling at fixed points Water supply by youth to other areas using trucks and carts	JM	Private and community boreholes, Water supply to other areas using trucks and carts
Institutions	NWSC: The utility abides by the service regulator (WASREB) to provide water at Ksh. 0.5 per 20L container	Informal institutions regulate prices in which case water prices can vary between Ksh. 3-5 for 20 L containers.	NCWSC	Informal institutions regulate prices in which case water prices can vary between Ksh. 3-5 for 20 L containers. Landlords decide to act as middle men between the NCWSC and the JM water users (tenants). Cases of hiked house rents to accommodate water charges have been reported by tenants.

Appendix 2: Conflict, conflict of interest and cooperation for drinking water supply

Water supply models	Conflicts or conflicts of interest (based on actors, technology and institutions)	Cooperation (based on actors, technology and institutions)
Model 1: Pre-Paid Dispensers (PPD)	**Local:** • Token holders sell water at Ksh. 5 as opposed to Ksh.0.5 for 20 L container to those without. • Water prices at the water point can differ. For individuals who draw water for domestic use, water is sold at Ksh. 3 but for those who buy water for re-selling, water is sold at Ksh. 2 • Vandalism of PPD equipment such as water tanks • Intra-youth group wrangles and sometimes, physical fighting had been reported due to mismanagement to a point of destroying the PPD tanks • The fact that there is no direct channel to recharge the tokens other than doing it using shop tags-only owned by a few people who also vend water, can lead to conflict. • It was reported that different groups sell water at uniform prices and should any group lure more customers by selling water at a slightly lower price, the inter-group conflict is likely to ensue until the prices are equalized. • When water is supplied after a long period of shortage and scarcity, scramble for water which at times leads to violence has been experienced at the water points **City-region:**	**Local:** • Acceptances by the community to buy water at Ksh. 5 for 20L instead of Ksh. 0.5. • Acquisition of water from illegal connection points at a cost without complaints but with understanding that water diversion and vending is for income generation. • Concerned residents e.g. KR2 take the initiative , at own costs to call the NCWSC officials to fix any water-related problems • The community is adaptive to water prices and willing to pay for it • Shanti Youth Group comprising of people of age between 12 and 42 years used money generated through vending water and car wash at illegally connected point to sponsor youth sports and nurture talents of the young people • Licensed water vendors (e.g KR11) who knew existence of people illegally selling water did not report to the authorities, as a way of protecting status quo and also maintaining peace which would be disrupted if they were reported. • For youth groups that sell water using carts, Ksh. 300 is to be submitted to the group account every day. In most cases, members

	• Water is highly rationed and at times PPD tanks are dry-Potential conflict between users, PPD caretakers and NCWSC • Water prices go further up when water is to be sourced from far on carts • Some officials help individuals connect water for sale when bribed. • Lack of public space has significantly made it difficult to increase the network of PPDs. The utility has had to negotiate with landowners to install water kiosks, which the owners have treated as theirs hence portending a potential conflict. **Provincial:** • Political affiliation and bias was perceived to be a major driver to inequality in water supply-such that areas perceived to be "politically correct" water is less rationed compared to other areas-potentially causing violence. Such shortages are largely thought to be stage-managed to benefit a few networked individuals either in the short-term (e.g to hike water prices) or long-term (eg to gain political support) **National: NA**	of the group on duty work hard to ensure that extra money is earned for their use. For example KR6 alluded that a cart with a capacity of 32 containers ferry water to various destinations and sold at Ksh. 25 per container. 6 trips can be made in a day earning Ksh. 4,800 out f which Ksh. 300 is sent to the group account and individuals earn Ksh. 4500 a day. This is a quite substantial income in a low-income community. • Aware of the fact that water is highly rationed especially during dry seasons, the members of Mathare have many water containers to store enough water for use during times when it is not supplied • The fact that water is sold at Ksh. 2 to cart pushers for re-sale instead of Ksh. 3 applicable for individuals who don't re-sale it is a form of cooperation that ensures a better profit for vendors. **City-region:** • The fact that NCWSC uses youth and women group to manage PPDs is a form of cooperation that brings mutual benefits. • A form of cooperation is manifested in the case where the NCWSC uses certain individuals to own shoptags for recharging tokens.

		• While the groups get an income through a 40% commission on the amount of money recharged on the shoptags, the company gets assurance of the security of the PPD equipment and in the long run reduces the cost of security. **Provincial: NA** **National: NA**

Model 2: Jisomee Mita (JM)	**Local**: • High levels of water rationing (Water supplied once in a week for about 8 hours) • Hiking of rent by landlord from an average of Ksh. 2000 to Ksh. 2500 so as to take care of water bill was reported. • Tenants have previously complained for paying for water which is not regularly supplied , to an extent that threatened not to pay for it but the landlords threatened them that they would be evicted if they fail to pay • Water is generally supplied at low pressure and it takes long to fill the containers. Some cases of physical fights have been reported where certain individuals would line-up several container to be filled before others could be allowed to fetch. • Discrimination at the borehole was evident in which case individuals who draw water for personal use are sold water at Ksh. 3 while those drawing water on a cart for resale buy water at Ksh. 2. The price is even hiked to more or about 66.7 % on Sundays when water is sold at Ksh. 5 for those who intend to use in the households but the same is not applied for the vendors who continue getting water at Ksh. 2. **City-region:** • Sometimes landlords fail to remit water bills to the company despite having been paid by tenants alongside rent. This has led to disconnection of water by the NCWSC. • More often, the NCWSC uses its staff to read the	**Local:** • Excess fresh water is stored in many containers for use on the days it is not supplied. Saline water is used to supplement fresh water especially in laundry. • A caretaker of an apartment had taken upon herself to advice people to embrace a "rotational" kind of fetching water. This mode, regardless of who comes first to draw water, everyone is allowed to draw water one container at a time, allowing others to do the same. • The level of cooperation is exercised when a hand-held cart owned by someone is stolen. It was reported that other cart owners come in solidarity and assist in the tracing the lost cart until it found, failure to which, money is raised to purchase a cart for the affected person. **City-region:** • A local Catholic church in Kayole-Soweto sold water to residents at a flat rate of Ksh. 2 instead of Ksh. 3 for 20L, as a way of easing economic burden to the less fortunate in the society **Provincial: NA** **National: NA**

	meters and determine the water bill. This contravenes the initial hope that each person would be able to read their meter and disseminate to the company. Disagreements have been reported on allegation that the readings made the staff from the company are incorrect **Provincial:** • A conflict was reported between a local catholic church and some officials from the Nairobi County Government who asked for bribe in order to be allowed to operate the borehole. The stringent measures were claimed to be applied to the church through many documents which were to be acquired and in some cases, upon acquiring the required documents, other forms of implications were introduced. **National: NA**	

This list is to be expunged and attached separately as it should be confidential

Appendix 3: List of Key Respondents (KRs)

No	Name	Label	Category	Date	Location	Tel.
1	Hellen Luku	KR1	Business lady and PPD water Vendor	12/11/2019	Mashimoni	0723154911
2	Clarice Akinyi	KR2	Social Worker	12/11/2019	Mabatini Ward	0723948016
3	Jack Wainda	KR3	Community Health Worker	12/11/2019	Mashimoni	0726662500
4	Judith Nyagi	KR4	Volunteer Community Health Worker	12/11/2019	Mashimoni	0728475618
5	Kitonyi Ndambuki	KR5	Businessman and PPD water Vendor for Mabatini Action Group	12/11/2019	Mabatini	0720935069
6	Stephene Mayukwa Butiko	KR6	Water Vendor on Hand held cart for Mathare Mashimoni youth Group	08/12/2019	Mashimoni	0797331905
7	Benta Aoko	KR7	Water Vendor (Individual Licensed and metered by NCWSC)	08/12/2019	Village 3A	0701566760
8	Agnes Mugo	KR8	Water User (Mahla Women Group)	08/12/2019	Village 3A	0721516254
9	David Ouma	KR9	Member for Mathare Progressive Youth Group	08/12/2019	Bondeni	0724315368
10	Evans Otieno	KR10	Member for Shanti Youth Group	08/12/2019	Village 3B	0768210240
11	Jacob Ochieng	KR11	Water Vendor (Individual Licensed and metered by NCWSC)	08/12/2019	Mathare Highway	0754725531
12	Gilbert Kamau	KR12	JM water User	13/11/2019	Kayole-Soweto	0718321138

13	Catherine Ngiendo	KR13	Caretaker in a flat of 30 families with JM system	13/11/2019	Kayole-Soweto	0708601485
14	Stephene Odhiambo	KR14	JM Water user	13/11/2019	Kayole-Soweto	0721956306
15	Samuel Masika	KR15	JM Water user	13/11/2019	Kayole-Soweto	0797744092
16	Karogu Wanjiku	KR16	Water Vendor using hand-held Cart	13/11/2019	Kayole-Soweto	No Contact (Never had a phone)
17	Angela Mbali	KR17	JM Water user in an apartment of 8 families	13/11/2019	Kayole-Soweto	0757484125
18	Lawrence Kibara	KR18	Catholic Lay Brother and Borehole water Vendor at Kayole-Soweto Catholic Church	06/12/2019	Kayole-Soweto	0728464378
19	Evans Wachira	KR19	Water Vendor using hand-held Cart	06/12/2019	Kayole-Soweto	0726098964
20	Ann Mumbua and Nehemiah Odhiambo	KR20	Water vendors at Kayole-Soweto PPD on behalf of Miami Jungle Movers CBO	06/12/2019	Kayole-Soweto	0726012013/07184 56836
21	Eng. Kagiri Gicheha	KR21	Manager, Informal Settlements Region	06/12/2019	National Water Plaza, Dunga Rd-Nairobi	0722768751
22	Eng. Ambrose Awiti	KR22	Manager in-charge of Kayole-Soweto NCWSC offices	06/12/2019	Kayole-Soweto	0726594957
23	Ms. Njoki Mwaura	KR23	Sociologist-NCWSC - Informal Settlements Region in Mahare	09/12/2019	Mathare	0723978573

Appendix 4: Interview questions, semi-structured.

Lead questions towards understanding the formal water regime

1) What are the key technological, political and institutional features of the formal water regime in Nairobi?
2) What is the perception of the urban water users in the low-income settlements about the formal water regime?
3) Is there a clear demonstration/understanding by the local community of their right to the formally delivered water supply as a service?
4) Have PPDs and Jisomee Mita demonstrated a measurable shift towards achieving sustainable water supply and sanitation in the informal settlements?
5) Is formal water rationing in low-income areas once in a week for about 8 hours, justified (by the community)?

Lead questions towards understanding the informal water regime

1) What are the main types of private, informal or semi-formal water enterprises common in these settlements?
2) Do the local actors in the informal settlements see a big difference between formal and informal water supply? Is this something that matters for them?
3) What kind of discourses and perceptions would best describe how water users view private water enterprises (e.g. 'illegal', 'good' or 'bad', 'formal', 'semi-formal' etc.)?
4) What are the main actors involved in the supply of these informal water supply services?
5) Where/how is the water sourced (e.g. illegal connections to the formal grid, or groundwater extractions etc.)? What is the quality of the water vis a vis the formal water supply system?
6) What are the key drivers (could be varying from personal to collective viewpoint) to the choice of sourcing water from a given supply system?
7) How does the local community perceive these enterprises vis a vis the formal system (e.g. in terms of cost, quality of water or other considerations)?

Lead questions towards understanding the modes of conflict and cooperation

1) How do the different actor groups at the local level interact between themselves and between them and water systems/infrastructure?
2) What are the main modes of conflict, conflict resolution and cooperation among the different actor groups at the local level?
3) What are the power relations between the different groups? How do the power relations influence conflict, conflict resolution and cooperation?
4) Who currently benefits and who loses from current form the current situation?
5) If there is little cooperation at present, how could a certain level of cooperation and harmonization be achieved in the future so that the formal and the informal regimes function in a more sustainable and equitable manner within the informal settlements?