THE TECHNICAL UNIVERSITY OF KENYA, NAIROBI

ROYAL INSTITUTE OF TECHNOLOGY SWEDEN, STOCKHOLM

Local Innovation for a Transformative Shift towards sustainable water and sanitation in African cities.

Case Studies on Pre-Paid Water Dispensers in Mathare Valley and Jisomee Meter Technology in Kayole

Research coordinator
Dr. Lewis Sitoki
Research supervisor
Mr. Benard Juma

Research assistants
Ouma Rebecca
Felistus Suter
Faith Cecilia
Georgin Nekesa

FINAL DRAFT REPORT:
January 15 2019

Disclaimer: This draft report is a working paper not meant for publication or citation. It includes a summary of the findings from field studies, based on which further scientific analysis and publication will be undertaken.

Preface

This report has been prepared for the study of Water Supply and Sanitation (WSS) Project on the “Local Innovation for a Transformative Shift towards sustainable water and sanitation in African cities”, a collaborative work between the Technical University of Kenya (TUK) and the Royal Institute of Technology (KTH) in Sweden. The research project is funded by the Swedish research council FORMAS (FORMAS 942-2015-857).

The field work was carried out by a team of investigators from TUK, Department of Geo-Sciences and The Environment in the course of 2018. Preliminary findings and the methodology have been discussed and gradually been refined in dialogue with the Swedish counterparts Associate Professor David Nilsson and Associate Professor Pär Blomkvist. Interpretations, issues of data management and reliability, field survey methods and overall conclusions have continuously been discussed between the partners. During October 15-21, follow-up field visits and interviews were conducted together with David Nilsson in Nairobi. The team appreciates the good spirit of collaboration between our two universities which has so far shown to be very productive and fruitful. Water and sanitation truly are global challenges and therefore, global cooperation is needed for arriving at sustainable solutions.

Abstract

The study focuses on technological and business model innovations piloted in Nairobi, with the aim of realizing effective WSS services in informal settlements of Nairobi. We investigate Pre-Paid Water Dispensers (PPD) Technology in Mathare Valley and Jisomee Meter Technology (JM) in Kayole.

The empirics used in this study was obtained through the collection of qualitative and quantitative data. The qualitative data was gathered by fieldwork and interviews with key stakeholders in Mathare Valley and Kayole. The quantitative data was obtained from Nairobi City Water and Sewerage Company (NCWSC.)

Results from the interviews, as well as data collected from NCWSC, strongly show that the two technologies, however well indented, have not adequately addressed the challenges of WSS services. There still exist a very complex *critical interface* between the water service providers and the local level water users. This interface is characterized by diverse range of competing interests in the water sector. This complex situation with many actors with different agendas is one of the most important reasons why the implementation of the PPD and JM technologies has not really worked so well and probably why it has not expanded /spread to other informal settlements.

Thus, the general purpose of this study is to investigate controversies in the interface between the regime level and the local level.

Acronyms

PPDs	Pre-paid water Dispensers
KR	Key Respondents
NCWSC	Nairobi City Water and Sewerage Company
ATM	Automatic Teller Machines
GLL	GrundfosLifeLink
NRW	Non-Revenue Water
SDGs	Sustainable Development Goals
WSS	Water Supply and Sanitation
WB	World Bank
JM	Jisomee Mita
MWI	Ministry of Water and Irrigation
WRA	Water Resources Authority
WASREB	Water Services Regulatory Board
BWRC	Basin Water Resources Committee
WSP	Water Service Provider
WRUA	Water Resources Users Association
WAG	Water Action Group
NGO	Non-Governmental Organization
AWSB	Athi Water Service Board
WSUP	Water and Sanitation for the Urban Poor
KWAHO	Kenya Water for Health Organization
CI	Critical Interface
IRC	Indirect Revenue Collection
NRW	Non-Revenue Water
DRC	Direct Revenue Collection
IWC	Illegal Water Connection
LWC	Legal Water Connection
CURC	Completely Unaccounted Revenue Collection
PARC	Partly Accounted Revenue Collection
IWS	Illegal Water Supply
LWS	Legal Water Supply
DIS	Directorate of Informal Settlement
TA	Technology Aspect
BM	Business Model
YGs	Youth Groups
LWU	Local Water Users
CBO	Community Based Organizations
TUK	Technical University of Kenya
KTH	Royal Institute of Technology

Table of Content

List of Figures

List of Appendices

1 Introduction

1.1 Background of the study

At least 60% of Nairobi's human population lives in informal settlements, a majority are low income earners and lack access to adequate safe drinking water at an affordable price. This situation is likely to be insurmountable due to the increased rate of urbanization and human settlement in informal areas. The Nairobi City Water and Sewerage Company (NCWSC) is the legally established body mandated with the provision of water and sanitation services for the Nairobi's residents. Significant success in water service provision has been largely achieved in formal sectors which are characterized by legal water connection and limited rate of water rationing. Informal sectors still face daunting challenges such as poverty, illegal water connections, water wastage, insecurity and insufficient property rights. The sector encounters high rates of illegal water connections through water diversions and water system failures such as leakage, pollution and high rates of water rationing.

In spite of inter-agency collaborative initiatives and donor-focused investments to reform the water sector as well as enable access to clean and safe water as a universal right, significant disparities still exist in water supply and sanitation (WSS) in Nairobi. For instance, illegal water connection is one major factor that leads to inequalities. Illegal water connection in the informal areas is largely caused by poverty and the need to earn a living through water vending. Most of the illegal water selling points are managed by youth groups and women groups. Other water vendors are private borehole owners and mobile cart pushers. Illegal water connection and vending has significantly contributed to revenue losses by the NCWSC as much of the water revenue collected ends up in the individual pockets and remains unaccounted for. Increasing rate of non-revenue water is arguably a complex factor which NCWSC has to deal with so as to ensure increased revenue and adequate water supply within informal settlement.

Numerous innovations through donor-funded pilot projects, community organisations or small-scale entrepreneurs are rarely scaled up, despite some being relative successful. Such innovations typically remain as marginal "add-ons" to the formal systems and have rarely been expanded. Others are frustrated by the wide network of people who benefit from a poorly co-ordinated system. One of the major strides undertaken by the NCWSC through the support of World Bank (WB) and local financial institutions in ensuring sustainable water

supply and maximum water revenue collection was the incorporation of technological innovations in water service provision and billing. Such innovative approaches include the use of Pre-Paid water Dispensers (PPDs) and Jisomee Meter (JM) technologies. The success of the two technologies lies in ensuring that local level consumers of water are integrated into the mainstream water supply system. But, manipulation of the technologies continues to hamper their operation and deny the local communities a chance to enjoy and appreciate efficient water supply.

2 Landscape level of the water sector in Kenya

The policies and regulations governing the water sector in Kenya are formulated by the Ministry of Water and Irrigation (MWI), which is the executive umbrella government ministry that ensures water service provision. The MWI sits at the apex of the water service function, below which other government agencies carry out specific devolved functions. Ideally, the functions of the MWI are categorized into two: water service delivery and water resources management. The management of water resources is done both at the national and county levels. At the national level, Water Resources Authority (WRA) and Water Service Regulatory Board (WASREB) are mandated to carry out water asset management and regulation respectively. At the county level, water resources are managed at basin level and user level. At the basin level, water resources management and sanitation services are done by Basin Water Resources Committee (BWRC) and Water Service Provider (WSP) respectively. At the local level, the management and provision of water services is respectively done by the water resources users association (WRUA) and water action group (WAG). Figure 2-1 gives the institutional structure of water resources management from the policy level to user level as outlined in the Water Act (2016) and in accordance of the constitution of Kenya (2010). According the constitution of Kenya (2010), every citizen is guaranteed the right to access to clean and safe water as a basic human right and assigns the responsibility for water supply and sanitation service provision to 47 devolved governments at the county level

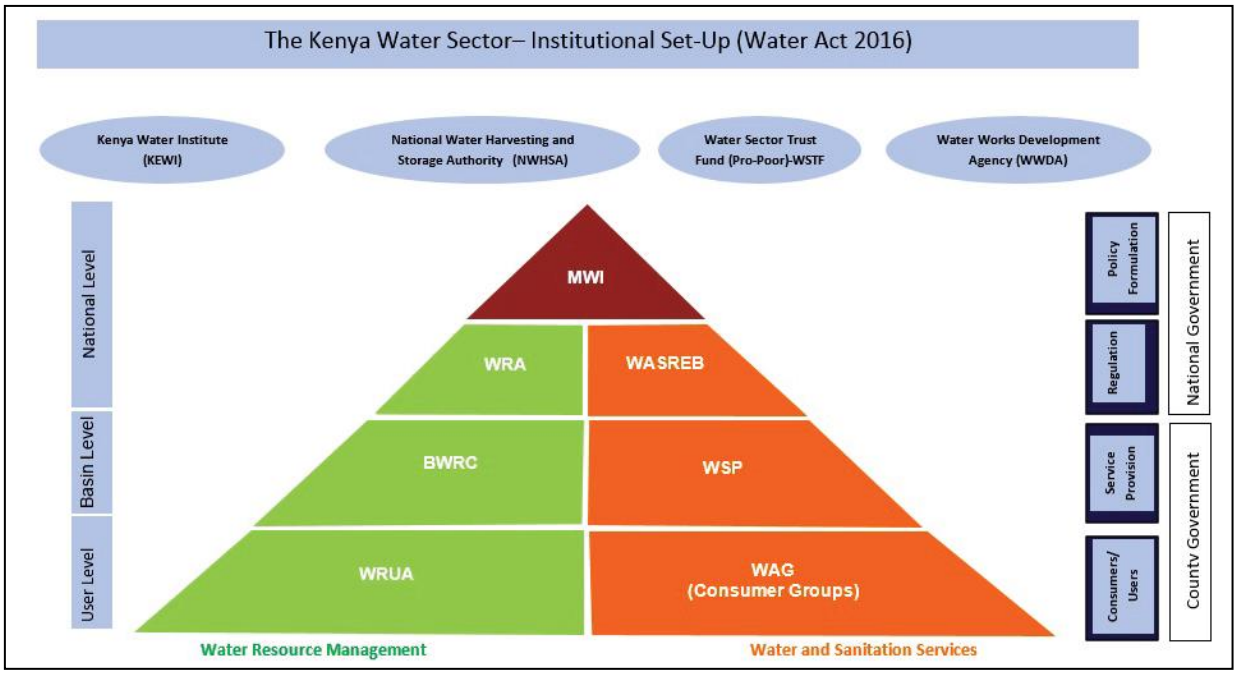


Figure 2-1: Institutional structure of water resources management (Source: Kenya Annual Water Sector Report 2015-2016)

3 Conceptual Framework and Methodology

3.1 Conceptual Framework

Water and sanitation services (WSS) in East African cities are characterised by a dichotomy between regular (connected) customers and those marginalised and unconnected, typically low-income people often residing in informal settlements. Informal and private services prevail in these marginalised areas, often exhibiting great ingenuity in innovative practices, which may include hybrid solutions and sometimes illegal connections. From the system 'owner' perspective – e.g. the utility or municipality – it can make sense to integrate new customer groups if incentives are right (political pressure, market opportunities, reduce illegal connections, revenue, peer pressure, pride) and if feasible socio-technical solutions for this integration exist (legal mandates, reliable technology, asset security, compatibility with main business model, payment modes, etc).

Our conceptual framework takes point of departure in the Multi-Level Perspective approach: that socio-technical change and innovation is governed by processes on three levels:

- the landscape level: legislative framework and policy, economic development, general value-sets in society such as civil rights etc;
- the regime level: organisations and technological systems, including knowledge and technology-specific rule-sets, e.g. a city-wide water and sewerage company;
- the local level or 'niche level' of innovation: small-scale experimentation with different socio-technical practices, done by smaller actor-groups such as NGOs, communities, private entrepreneurs, or through dedicated 'pilot' projects by larger organisations.

We define the space between the formalised system (regime level) and its margins (local level) as a "critical interface". This interface is porous and exchange (of services, money, social capital, values, technology) is taking place across this interface all the time.

What this study was keen to analyse, is the quality of this exchange and to what extent the local and regime levels are – or can become - aligned with each other as illustrated in figure 3-1.

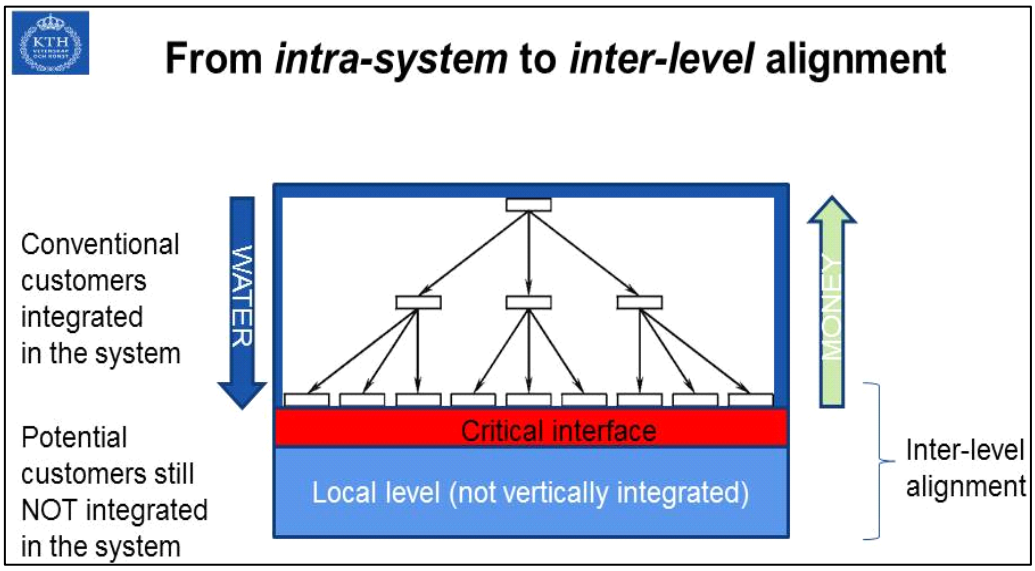


Figure 3-1 Conceptual model showing the Critical Interface between regime and local level

In essence, figure 3-1 shows that there are two distinct "flows" in a water system: the *outflow* of water to peripheral users and the *inflow* of money to the regime. These flows have the ability to cut across the critical interface.

Building on earlier research, our point of departure is that the success or failure of service provision in low-income and marginalised areas depend on the level of alignment between the regime and the local level.[1] Thus, we claim that *Inter-level alignment* is a key.

Alignment is about how well innovations at the local level are compatible with regime level standards, objectives and practices. The quality and extent of alignment, just like the quality of exchange across the critical interface, decides the pace of integration and thus the quality of services in marginal areas.

It should be noted that *Alignment* should not be understood as the roll-out of universal service provision by means of a standardised universal, one-size-fits-all technological configuration. Alignment means acknowledgment and integration to some degree, so that service provision (in whatever socio-technical fashion) in informal and previously disenfranchised areas becomes a part of the regime actors' business models, operations, and service development.

Our investigations focus on understanding alignment and the exchange across the critical interface and how misalignment or "controversies", are detected, managed and mitigated by

[1] Blomkvist and Nilsson – ref to article in Water alternatives

the actors populating the interface. The general purpose of this study is to investigate controversies in the interface between the regime level and the local level.

In our study we analyse controversies in the interface in three dimensions:

(i) The **distribution technology**: by what means is water distributed to local level users?

(ii) The **business model**; how is value generated and captured through revenue collection?

(iii) The **socio-political factors** that influence the dynamics in the critical interface.

The third dimension was added to the first two when the field study had started, as it was obvious that this dimension was needed to capture the dynamics of the controversies. The questionnaire in the appendix does not outline these questions, which were developed in a more flexible manner.

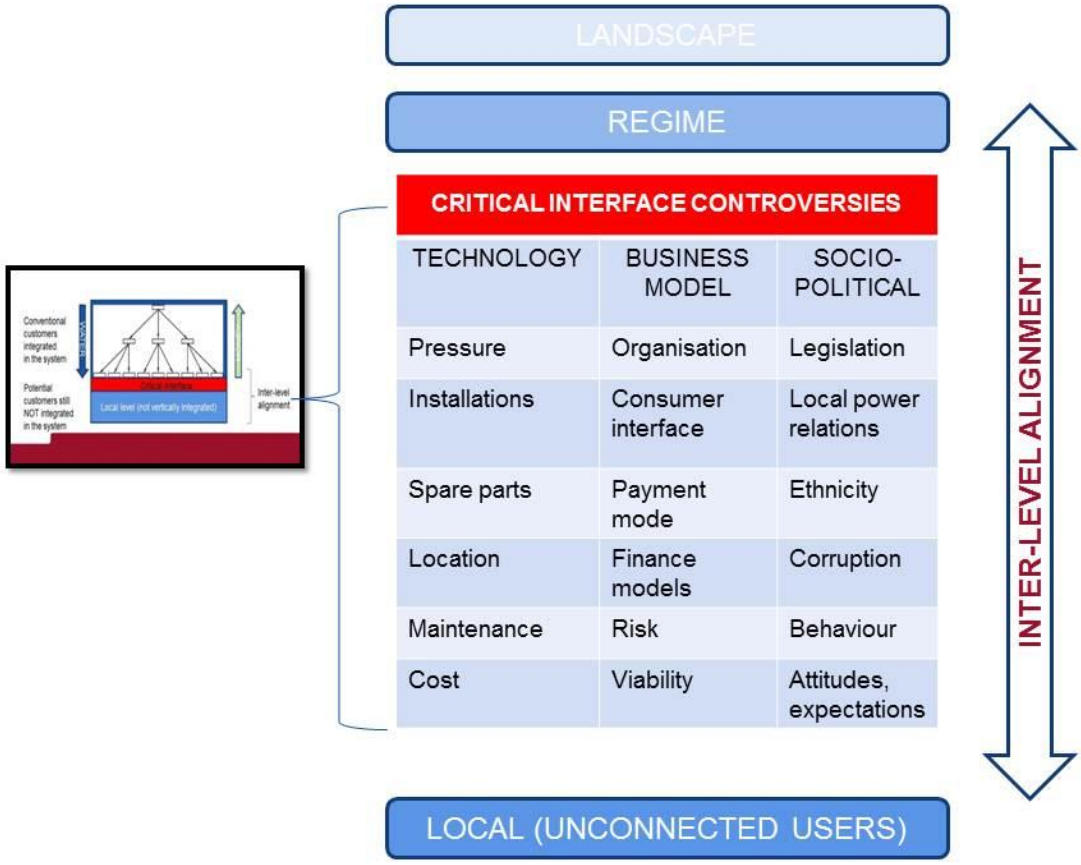


Figure 3-2: Mapping how actors deal with 'controversies' at the critical interface

3.2 Methodology

3.2.1 Qualitative method:

We carried out interviews among key stakeholders in the water sector on the technological aspects of water supply as well as on business model and socio-political aspects.

The interviews were based on a questionnaire (see appendix) and were mainly performed in a semi-structured way.

The main water stakeholders who were targeted in were clustered into three tires (Levels) categorized as Tier I(T-1), Tier II (T-2) and Tier III (T-3) respectively.

T-1 included the grassroots water suppliers and users. This category largely influences water supply and business within the community. They included:

(i) Local water vendors who use PPD and JM technologies and directly connected to the water grid through legal means by NCWSC (Legal Water Connection-LWC)
(ii) Local water vendors who neither use PPD or JM technologies but have direct connection to the NCWSC water grid through illegal means (Illegal Water Connection-IWC)
(iii) Local water vendors who own private bore holes in their plots
(iv) Local water users (LWU), who obtain water from any nearest source (whether technology-driven supply or other means)

T-2 group included a conglomeration of specific influential entities and opinion shapers within the community. They included:

(i) Local Youth Groups (YGs), Women Groups (WGs) and Community-Based-Organizations (CBO)
(ii) Local Leadership (Community Chief/administrator), Village Elders and social workers

T-3 category included policy-established corporate bodies in water sector, and their roles is largely policy-based and have limited contact /touch with the community, hence their influence on water supply is limited to the scope of their establishment. They included:

(i) Nairobi City County-Ministry of Water
(ii) Nairobi City Water and Sewerage Company (NCWSC)
(iii) Water Services Regulatory Board (WASREB)
(iv) Non-Governmental Organizations (NGOs)

3.2.2 Quantitative method:

To evaluate the success (or failure) of the PPD and JM technologies, we defined parameters which were analysed based on empirical revenue collection data supplied by the NCWSC (see below, chapter 4.3)

4 Results and Discussion from Case studies

4.1 Case study I
Pre-Paid Water Dispensers (PPDs) in Mathare

4.1.1 Abstract

The Pre-Paid water Dispenser (PPD) technology is an initiative by the NCWSC to enhance water supply and sanitation services at an affordable price of Ksh.0.5 per 20litre container in informal settlements within Nairobi. This study aimed at investigating the controversies that exist at the service provider-local level user interphase. The assumption made is that there exists a critical interface with controversies that influence effective/ineffective water and sanitation services envisioned by the PPD technology in Mathare valley. The study focused on the business model (BM), technological distribution and advantages as well socio-economic and political factors influencing the success and/or failure of the technology. We compared the rate of water revenue collection with the water supply.

Qualitative data was collected through questionnaires, in which a total of 17 semi-structured interviews were done for the period between March and April 2018. .The Key Respondents (KRs) were drawn from the residents of the three out of six wards within Mathare constituency where the technology is being implemented. The wards in which interviews were conducted are Mabatini, Hospital and Mlango Kubwa with a total of 31 PPD kiosks. The KRs were the PPD users, group members manning the PPD kiosks and the traditional water vendors. Quantitative data which showing the amount of water supplied (in UNITS-LITRES) as well as revenue collected between 2016-2018 was obtained from the NCWSC.

The findings show that 38.7% of the PPDs were functional for the entire period of the field work. 22.6% of the PPDs were reported to have no water supply in the preceding three weeks due to the diversion and illegal connection. Irregular supply of water by the NCWSC from the main grid and by the water carrying trucks. Moreover, 16.1% of the kiosks had dysfunctional PPDs and had not been repaired for the past six months.6.5% of the PPD points remained dormant and the KR reported to be unaware of the cause of their inactive state. The KR reported lack of repair and maintenance of the PPDs, pipes and tanks. At least 16.1% of the PPD kiosks were reported to lose significant amount of water through tank leakage.
Most of the residents reported difficulties in acquiring the water ATM cards due to ignorance (lack of information by the residents on where and how to get the card) and attached conditions such as disclosure of personal information prior to acquisition of the card. . Personnel manning the PPD kiosks largely enjoy the privilege of owning the water ATM cards and use them as business tools to sell water to the local communities at Ksh. 5 as opposed to Ksh.0.5 for a 20litre container. In the process of selling water at this exaggerated price, the water ATM card is charged Ksh.0.5 by the NCWSC as mobile revenue out of which 40% is payable back as commission to PPD caretakers. This therefore means that the personnel in charge of the PPD kiosks gets Ksh.4.5 in addition to Ksh.0.2 for every 20litre container that translates to 940% individual profit achieved.
It was found that Mathare Valley is prevalent with illegal water connections from which individuals and/or groups generate income. Most groups reported existence of conflicts related to the income generated from vending water. For instance, PPDs are managed by youth and women groups who manage water kiosks on shifts. Cases related to lack of clear financial accounting by the individuals on water vending shift was attributed to the source of

mistrust and conflict especially among youth groups. It was reported that in situations where the conflict is unmitigated, the physical destruction of PPDs happened so as to occasion loss to the whole group and any efforts to repair the damage was resisted.

Our interview with the Water Resource Regulatory Board (WASREB) show that establishment of PPD technology in Mathare was a top-down approach in which community engagement and consultation was very limited. Local level awareness, community involvement and participatory planning remain a key gap for the ultimate success of the technology. Political influence on the on the PPDs was also evident. Most KRs displayed a common understanding that the installation of PPDs was as a result of influence and priority goal by the local level political leaders. It was understood that the fact that the PPDs were manned by the youth and women groups, it was a way of creating youth and women employment opportunities. Some KRs confided that the composition of the youth and women groups and the entire management of the kiosks was politically skewed, such that most of the groups had similar political and views and beliefs with the incumbent political leaders[2]. The process of water vending is hence viewed as a political reward and the proceeds obtained are largely perceived to benefit the groups and not the NCWSC. The ultimate goal is to have a mutual benfit between the groups and the political leadership, such that the groups enjoy the revenue collected as they offer political support to the political leadership.

In conclusion, the NCWSC continues to make great loss of revenue due to illegal connections, cartels, lack of community support, unstable revenue collection systems, local level socio-political and economic dynamics among others. Controversies within the critical interface continue to thrive and widen, making the technology benefit only a few people with direct contact to it, thereby making huge profits at the expense of the very reason of the establishment of the technology.

The findings of this study are supported by quotes from KR. For security of the KRs, we assign identification to each respondent in the format KRPPDx_mm:ss_2_mm:ss, where x is serial number of KR and mm:ss_2_mm:ss is the range of time minutes (mm) and seconds (ss) where important information is derived from audio clip..

[2]One KR alluded to political activities such as donation of water tanks to groups as a tool to win votes

4.2 Data analysis, Results and Discussion

Appendices provide a transcription of KR and the type of questions asked and respective responses. Twelve (12) out of the seventeen KRs were PPD users. Two (2) were water vendors who sold water from the PPD machines. One (1) was water vendor who sold water from illegally connected pipes while two (2) were community social workers. There was one (KR 14) who was neither a vendor nor PPD user but rented part of the kiosk for own tailoring business.

The results displayed herein arise from structured and/or non-structured interviews with water vendors in Mathare Valley. The interview aimed at compiling feedback on the technological and business model of the PPDs as well as documenting the achievements, challenges and state-of-art of the technology within the area.

Two Key Respondents (KR), one a sociologist and correspondent of NCWSC and another sociologist interested in water supply from CBO perspective were interviewed through structured approach based on the questionnaire guide. Generally, the questionnaire interviews were "technical" to most of the respondents thereby making it easier to simplify the questions through non-structured approach. The detail of this non-structural interviews will be transcribed and be part of the final report. Appendix4 gives the details of the KR.

Our findings are in threefold: (i) Technological, (ii) Economic and (iii) Socio-political aspects

4.2.1 The Technological Aspect

From our fieldwork, we realized that between successive water ATM points, several individual water vendors, mostly with illegal water connection exist. "We have not had water through this kiosk and instead we use water through this pipe diverted by a local youth group. The tank storing water for the PPD is also broken and nothing has been done by the Nairobi water to repair it in spite of us making several calls to them" (KRPPD1_00:00_2_01:40, KRPPD13_01:00_2_2:20). A majority of the water vendors are resident youth of Mathare valley. Lack of employment is largely the justification tied to this illegal connection. "Most youth in Mathare lack employment and prefer water vending as a source of income. When we came up with PPD technology, we saw the need of sustaining them in business such that they would be entitled to the 40% commission for revenue collected through the use of ATM card to sell water. Some youth found that the 40% was insufficient for them and resorted back to illegally connecting water and selling at their own set prices. This gives them quick money. In fact when we came up with this technology, they were unhappy since it would threaten their water selling business" (KRPPD2_51:41_2_53:30, KRPPD5_08:15_2_08:20). It was noted that

the youth themselves form a wider network of water cartels within Mathare (KRPPD2_04:06_2_05:00, KRPPD5_11:50_2_12:10). The general populace seem to have reconciled their lives with this kind of arrangement. Water from illegal connection is largely treated as the primary source of water and the PPDs is only an alternative, arguably due to the fact that the PPDs are few and are unable to meet water demands of a growing population. The prevalence and continued expansion of illegal water connection can potentially compromise the usability of the ATM cards to draw water. Water prices for the PPD kiosks vary between Ksh. 3 to Ksh. 5 depending on the availability of water. The vendors with illegal water connection sell water at Ksh. 5 to Ksh 20 for a 20 litre container depending on the season.

The distribution of PPD machines is poor since the NCWSC relies on the good will of the Mathare residents to get space for constructing kiosks and installing the PPD machines. It was reported that the NCWSC envisioned to have the PPD installed at an interval of 50 m apart. This motivation is highly frustrated by lack of space which has led to many PPD machines lying idle in the NCWSC stores (KRPPD2_22:00_2_23:00). "....I can't go for water at a far distance simply that it cost 50 cents, I get water here at Ksh. 3" (KRPPD8_04:00_2_04:13). It was reported that some landlords procured PPD machines from organizations such as Maji Milele and installed them in their compounds with connections from NCWSC. They would then sell water to their tenants at Ksh. 10 per 20 l container but channel Ksh. 0.5 to NCWSC (KRPPD2_40:10_2_41:45). This claim could not be independently verified our fieldwork was not contacted in private premises within Mathare, but coming from a KR, we found it interesting as then the landlord exploit the tenants using the PPD technology.

Figure 2:1 shows the distribution of usability of the PPD technology from the number of people interviewed.

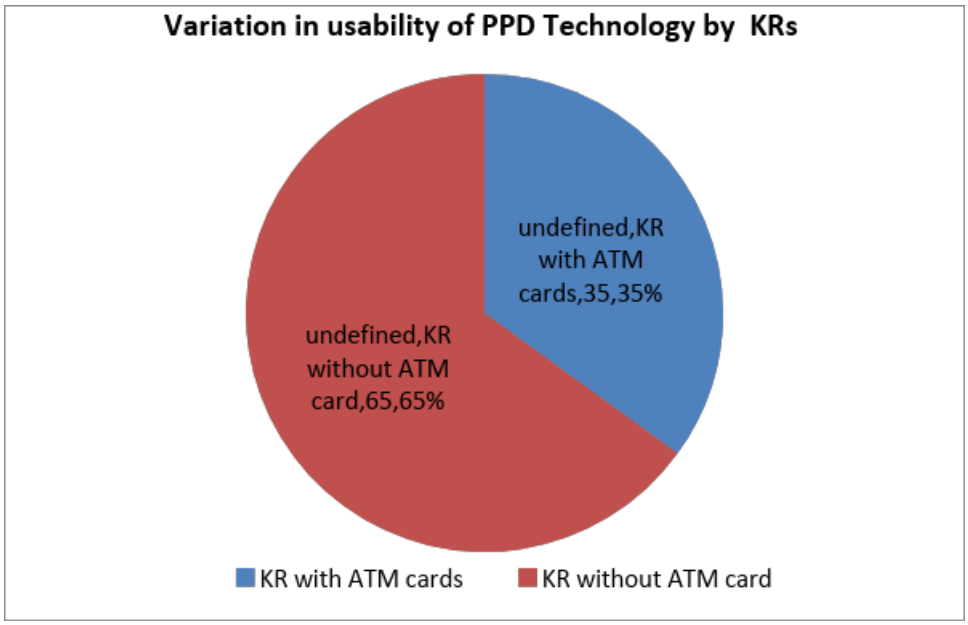


Figure 4-1: Representation of use of technology as from the number of people interviewed

From the perspective of utilization of the technology, the following were noted:

i. Most of the community members do not have the cards due to ignorance and also fear of disclosure of personal information such as identification card, KRA pin and information regarding next of kin. "This technology has got its challenges. To get the a card, one is needed to submit his/her personal documents including KRA PIN (KRPPD5_10:50_2_11:23). This scares people who think that they will taxed by the government. "...most of the people who draw water are women, so we wonder why we should give KRA pin, who do they (NCWSC) think is willing to pay tax? I would rather pay water at Ksh. 30 than paying tax" (KRPPD5_12:30_2_13:13). For National ID card, people have perception that this is a ploy to rig votes during election(KRPPD5_13:13_2_13:25, KRPPD9_07:55_2_08:03).

ii. Some of the KRs noted that it takes quite some time to re-charge the ATM cards due to non-automation of the ATM machines to load the token. "…it takes a long time to top up the card" (KRPPD3_03:21_2_03:50).

iii. A number of PPD users reported leaking water tanks and faulty ATM machines[3]. The NCWSC takes a long time to respond to the mess (KRPPD1_01:14_2_01:22, KRPPD16_0:10_2_0:27). "...There is water in the tank but no pressure to push water. It has not been rectified" (KRPPD17_00:12_2_2:00).

iv. A number of PPD users pointed out that the PPD kiosks lacked continuous water supply partly due to illegal connection and lack of water at times. Due to insufficient

water supply, water rationing is high. Every village is scheduled to receive water on specific days of the week, failure of which youth mobilize and protest, posing social insecurity and possible vandalism on the PPD machines (KRPPD2_24:32_2_25:40).It was also reported that only two water trucks exist to supply water to Mathare during the time when water is not channelled through the pipe. It gets difficult to reach the entire Mathare as water delivered at one section can be exhausted in a few hours with more in demand (KRPPD2_29:5_2_30:15). “These machines fail a lot. Some time you don’t understand why water is not released. This is worsened by prolonged water rationing in which span to weeks. Most of kiosks are idle in the slum” (KRPPD12_03:00_2_04:40).

v. In certain instances, KR with ATM cards lack tokens which must be supplied by NCWSC on request, which takes long to be available “We don’t have ability to recharge the cards ourselves and hence when our cards run out of credit, we cannot draw water until someone mandated to recharge it does it” (KRPPD3_03:21_2_03:50) and in the absence of an officer from Nairobi Water , no person could get the card readily (KRPPD5_09:40_2_09:50).

vi. We found a total of two PPD water kiosks in a dormant state due to lack of water supply since inception. Other kiosks were dormant due to bureaucratic challenges that ensue when identifying and selecting a group to run the kiosk. “There are many youth groups in Mathare and it is difficult to identify which group to run the kiosk. Instead, we as youth have our own cards which we can use to sell water to the public without cards at any kiosk at Ksh. 5 for a 20 litre container” (KRPPD3_06:20_2_06:30, KRPPD5_12:10_2_12:25).

Vandalism of the PPD machines by the locals resulted from anger due to water supply failure/delays(KRPPD2_20:00_2_21:11), in-fighting between the groups) on who should manage the PPD kiosks(KRPPD3_05:17_2_05:29 (“…PPD technology has resulted to fighting among some self help groups themselves on who to take charge. This management was corrupted and it led to almost closure of this ATM but I intervened and mobilized my fellow women to fight for our rights like the right to access of water.”) (KRPPD_)“These PPDs have no benefit to us. Even those with cards are complaining that water supplied is dirty and they cannot drink it. We shall be destroying these PPDs very soon” (KRPPD7_05:16_2_05:36).

vii. Lack of community participation on the technology, its use and benefits was largely expressed. It was reported that this technology was initially installed at night in individuals’ houses without prior public engagement, for this local communities

resisted (KRPPD5_02:42_2_03:50, KRPPD12_02:00_2_02:25). “....people just brought the tanks and we were told that we should start using this technology to get water” (KRPPD4_07:00_2_07:50). “....we simply draw water from the machine but we don’t know a lot about this technology since we have never been educated about it” (KRPPD4_08:30_2_09:15). “...understanding of the operational model of this technology has been a challenge to the community” (KRPPD5_01:28_2_2:34). “....some people said that since we have not been involved in this technology; let those interested in it acquire the ATM card. I acquired one but I could not use it due to lack of knowledge as we were not educated on it” (KRPPD5_05:28_2_05:48). “...This thing was just imposed on us. We are just struggling to know, we are just struggling to operate, we are just struggling to manage, but we are not in it. The system is out of us” (KRPPD5_24:00_2_24:30).

viii. Lack of strategic offices and contacts to refer to in case of a problem with the technology. “As a social worker, I do a lot of work voluntarily but Nairobi water does not offer support to my effort to ensure the community gets water. I use a lot of resources to communicate to the Nairobi water on behalf of the community. No water now for two weeks. I don’t have money to call Nairobi water” (KRPPD5_17:35_2_18:30). “.....whenever there is a problem with the machine, we don’t know who to approach. You have to call very many people who decline to address the problem but refer you to another person who also claim it is not them to address the problem.....You are taken round and round until you get tired. Nairobi water works in a non-coordinated way ” (KRPPD5_20:18_2_24:00). At least one kiosk lacked a tank that would store water since its inception. One second generation PPD (PPDG-2) machine was reported to have mechanical problem. “...the challenge with this newly installed machine is that it has not operated for two months now, it has mechanical problem and we do not know how to fix it” (KRPPD5_07:15_2_07:30). “....we have requested Nairobi Water to bring us a tank but they always promise to do so without action. We got tired of it and decided as a group to buy our own tank” (KRPPD9_08:50_2_09:45). “This machine has never had water since it was installed and Nairobi water have never told us the reason for lack of water. So we don’t use it” (KRPPD14_00:00_2_2:20).

ix. Most kiosks have no proper piping of water from the main grid and are never functional when there is no water in the tank. At one section of Mathare, illegal water connection 100m away diverted all water that would otherwise be channelled into the

PPD kiosk. It was reported that the Engineers sent on the go round to rectify and do a reconnection didn't complete the task on perception that Mathare is "chaotic" (KRPPD5_14:32_2_15:35). ".....This tank is broken and cannot hold water. It has not been replaced. They (Nairobi water) claim that the tank was broken by the locals during a fight and should replace it by themselves" (KRPPD9_00:20_2_01:40).

x. The NCWSC uses trucks /to supply water to the PPD kiosks, this was reported to be taking a long time of at least two weeks, prior to our visit.. "..The technology is good. The problem is that we have to use our airtime to call Nairobi water to bring water. It is now two weeks without water. If I don't call, no water will be brougth" (KRPPD5_07:35_2_08:48). "....whenever there is no water, I call Nairobi water for delivery using trucks" (KRPPD6_10:58_2_11:12). "This PPD was brought here when we had a serious water shortage, even our own pipes never had water. But when we started getting water, we don't use nowadays. It can not just be used easily, it has a lot of procedures which many people are not used to. Most people are illiterate and cannot use the card. Supplied water is also dirty at times and cannot be trusted" (KRPPD10_00:40_2_2:30). "..this technology can be of great benefit especially when illegally connected water is stopped and people are trained on how to use it. My grandmother cannot use it, also when its cleanliness is observed. I have never seen the tank cleaned yet water from it is dirty. I am one of the people who don't use because of the dirt water" (KRPPD10_03:10_2_04:40). "This machine does not work. There is no pipe for channelling water and it has never been improved" (KRPPD15_0:38_2_2:00).

4.2.2 The Business and Economic Aspect of the technology

It was noted that a majority of the residents lack water ATM cards and hence do not enjoy the benefits of the technology in the area. As a result, they have to use the cards owned by personnel manning the water kiosks who charge them Ksh. 5 per 20 litre container. The revenue collected by the NCWSC as a result of using the card owned by the water vendor at the PPD kiosk is Ksh. 0.5. This means that the revenue unaccounted for is Ksh. 4.5. This gives an impression that to a large extend, the PPD technology has not solved the water supply problem in its current state. This is because, the technology seems to have been literally "hijacked"(KRPPD2_47:00_2_48:00) by a clique of groups and individuals with special interest of making water business out it and ensuring that the intended purpose of the technology is unsuccessful. Most of the individuals owning active cards are largely from the youth and

women groups, for which they sell water to the locals. Some CBOs mandated shot tag tokens with responsibility of recharging end user tokens fail to do so , instead, they opt to use their cards to sell water to the public (KRPPD2_47:00_2_48:00). "... I am not a resident here but I do my tailoring work in this kiosk. I have my own card which I also use to sell water to those with no ATM cards" (KRPPD6_00:20_2_00:28). One water vendor at an illegal connection point said "...I am not concerned with the PPD, I have no job but I sell water here at Ksh. 3,...we don't charge sell water to group members or their relatives, we give them for free" (KRPPD7_2:00_2_8:00, KRPPD8_01:23_2_01:30). When water in the PPD is not supplied, we hike our water prices (KRPPD7_06:20_2_06:26). It therefore means that a majority of the local community members are not integrated into the system and continue to pay dearly for water supply and sanitation services. This has an impact of widening the critical interface, and increased collection of unaccounted revenue. It was reported that the primary aim of NCWSC was not to maximize revenue collection but to ensure access of clean water to low income communities at an affordable price (KRPPD2_45:00_2_46:00), but some local communities felt "undermined" that they could not afford water at Ksh. 5 (KRPPD2_08_2_9:13). Illegal water connection by individual water vendors also limit the amount of water getting into the PPD kiosks, as a result, water inflow is reduced. The overall result of this arrangement is that revenue is lost by NCWSC, increases of water prices and decrease of water supply as per figure 2:2 below.

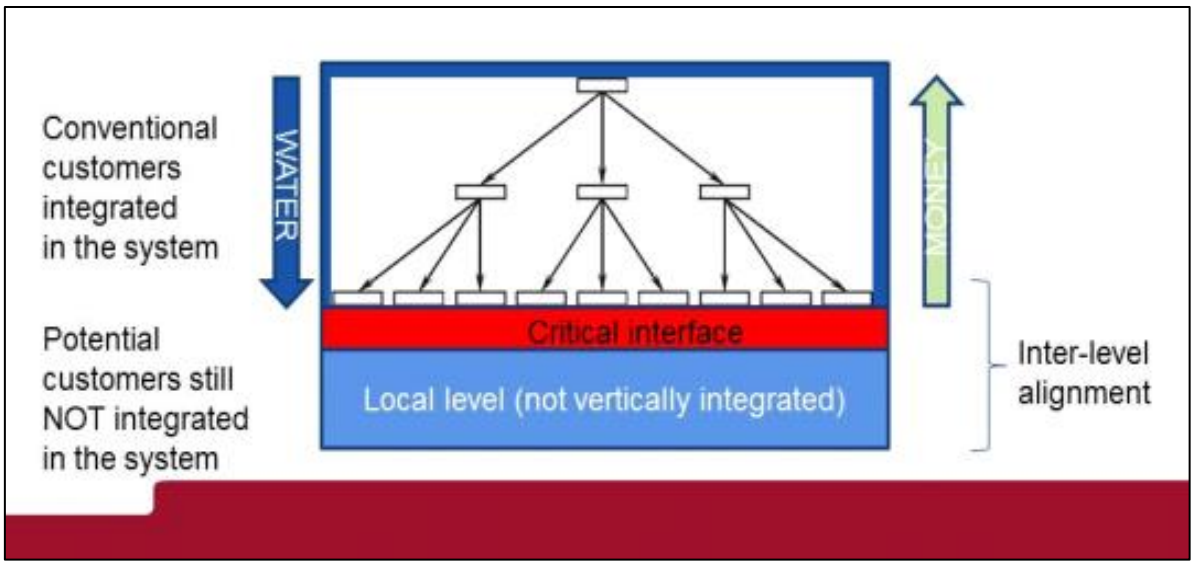


Figure 4-2: Critical interface between the regime and local level

i. Figures 2:3, 2:4, 2:5shows how the water revenue by the NCWSC diminishes. It is noted that the NCWSC collects only Ksh. 0.5 from the water vendor at the kiosk in

passion of water ATM. This money is charged automatically. But by selling the equivalent amount of water at Ksh. 5, Ksh. 4.5 is not accounted for by the company. The percentage profit achieved by the water vendors translates to 900%. It is also important to note that the NCWSC gives a 40% commission to people with the water ATM cards, hence by charging Ksh. 0.5 for every 20 litres of water from the ATM machines, 40% of this goes back to the card owner, hence enhancing the income of the water vendor and reducing the revenue collected even further. The resultant water charge by the NCWSC for every 20 litre container is Ksh. 0.3 while the water vendor pockets Ksh. 4.7. "...when we top up the card with Ksh. 1000, we get commission of Ksh. 400. This is helping our group to generate income. The Ksh. 400 is profit of the group" (KRPPD9_05:35_2_05:56). Given the nature of social and political dynaminism in many informal settlements of Nairobi, water shortage is artificially occasioned and hence water prices are freely set by the suppliers in the slum set-up. This is likely to be beyond he control of NCWSC. "...I sell water here , ...the only advantage with this PPD is that you get water at 50 cents, but sometime water is not supplied, so we lack water most of the time and resort to regular pipes (illegal connection)" (KRPPD11_02:00_2_02:16).

Some people reported that due to lack of prior education on the usability of the technology, they incurred losses unknowingly, in which case people found it difficult when to press a "STOP" button on the PPD hence water flowing to waste at a cost (KRPPD5_22:10_2_22:40). Social conflict in the community also played a role for directing someone where to draw water from. Someone would rather go for water at a distant kiosk than from a nearby kiosk perceived to be manned by an "enemy" (KRPPD5_37:00_2_37_40).

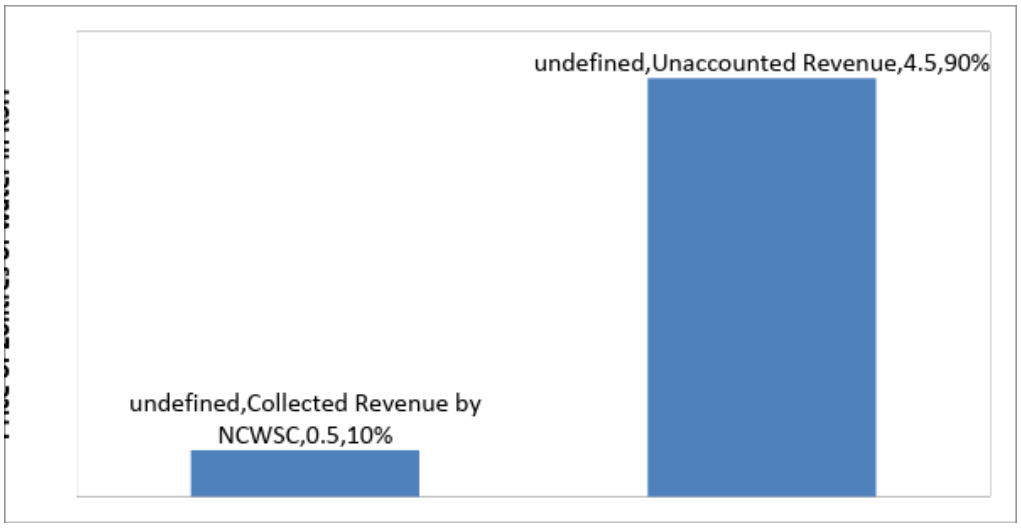


Figure 4-3: Comparison of the water revenue collected by the NCWSC with the unaccounted revenue

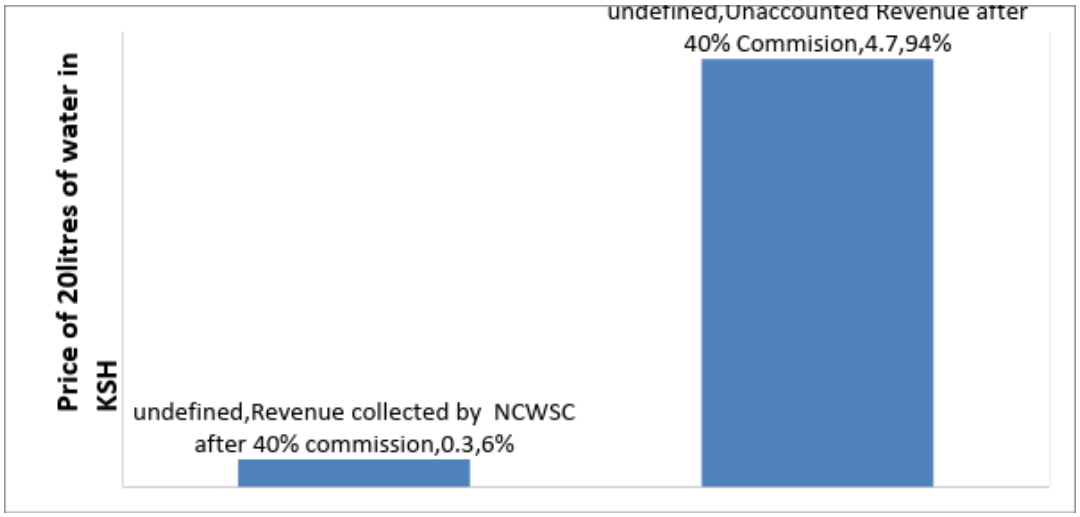


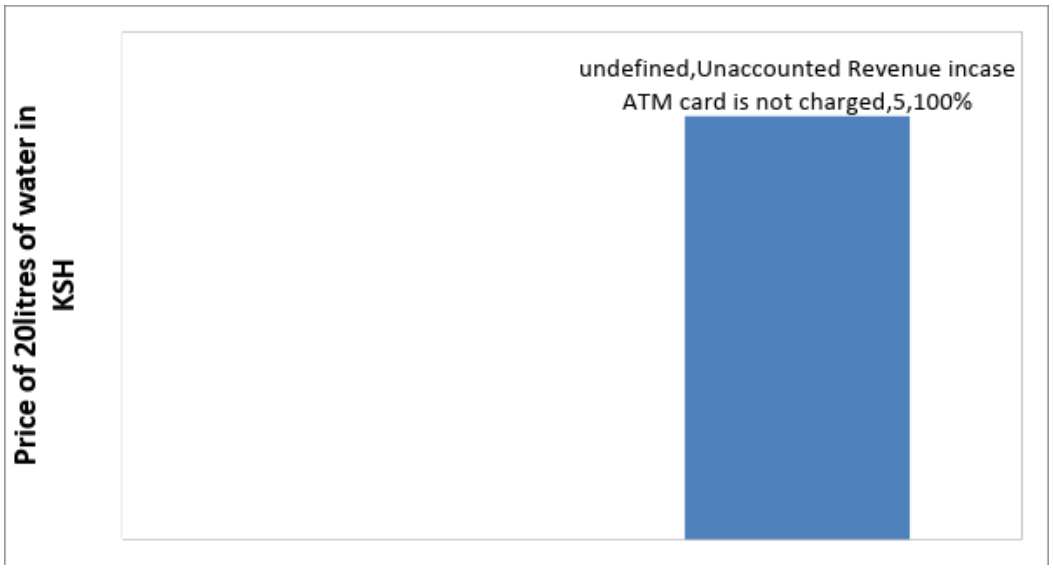
Figure 4-4: Comparison of the revenue collected by the NCWSC after 40% commission deduction with the uncounted revenue

The following key points can be noted from business perspective:

1. All the group members who are in charge of the PPD water kiosks sell water using their tokens to the community members at Ksh. 5 for 20 litres but the money deducted from the card is Ksh. 0.5 for the same amount of water. These water vendors make a lot of money that does not get to NCWSC. It was reported that group members and their relatives often get water at no cost at points with illegal connections. ,...we don't charge sell water to group members or their relatives, we give them for free" (KRPPD8_01:23_2_01:30). "...The token only benefits the group members since they get commission from the Nairobi water whenever they buy credit.

They also sell water at Ksh. 3 to the locals without card" (KRPPD11_07:50_2_08:15, KRPPD12_10:40_2_10:45).

2. In the event that the cards of the PPD water vendors are not charged with money, then they resort to siphoning water manually and sell it to the local communities. As a result, the Ksh. 05 charged by NCWSC is lost. In this case all the Ksh. 5 goes to the individuals and no revenue is channelled to NCWSC.



On average, a family of five persons in Mathare uses 60 litres of water per day, then from statistical point of view, Mathare valley with a population of 80,300 (Kenya census Report, 2009), it can be noted that the NCWSC losses Ksh. 1,132,356.90 per day and gets only Ksh. 72,278.10 or even much less. This may not be sustainable and could work against the success of the technology.

4.2.3 The Socio-Political Aspect of the technology

Mathare is one of the most politically active informal settlements in Nairobi. Water is one of the direct factors affecting human livelihoods and hence it has the potential to attract socio-political contestations.

The following was found to be closely linked to the social and political aspects of the PPD technology in Mathare

i. It was noted that as a result of lack of maintenance of the water tanks, many local communities use water from the PPD machines for laundry work only but water for drinking and cooking is drawn from individual water vendors who mostly have illegal water connection. "….when they are refilling the tanks, the water trucks just pour in water without taking care of some dirt getting into the tank. This is water that we

drink and only God will protect us. We find it with some smell and it is only good washing clothes. The community is compl;aining that lack of piped water at the time trucks suppy water was exposing them to health hazard....how clean is clean water, people are complaining, we just drink this water but God cares" (KRPPD5_22:50_2_25:40). "I use this water for washing but when it comes to drinking, I don't trust it. I have to buy from other source water for drinking" (KRPPD5_35:00_2_35:50). ".....We were told that this project belongs to the governor" (KRPPD7_2:00_2_8:00, KRPPD8_01:23_2_01:30). "....It is a good thing to have such a technology in a slum. But it is not just enough to bring a PPD here, people should be educated on how to use it. Not everybody is literate, not everybody is educated, we have some people who we should just guide on how to use the machine" (KRPPD10_05:35_2_05:48).

ii. A certain level of "ego" and status is attached to the PPD machines such that people draining water from the machines are perceived to be "poor" who can only afford water at Ksh. 0.5 as compared to those who buy the same amount of water at Ksh. 5.(KRPPD2_40:10_2_41:45). With time however, may have come to realize that PPD is a good technology to support water provision at low prices. The concern about water availability is still high. "people now know the importance of this technology. But if you use this water for your business, water may fail to come without your expectation. You have now to leave your business and go for water elsewhere at a much higher price" (KRPPD5_39:30_2_40:52).

iii. The government encourages formation of youth and women groups so as to easily access to the youth and women fund set aside by the government as loans. The loan obtained is supposed to be used by the groups in business activities and empowerment. It turns out that the groups are also very instrumental in driving local level politics, which is often aligned based on tribal sets. The mobilization of votes turn out to be inclined to the specific tribes. Tribes with numerical strength likely end up getting political leadership and the communities, whose tribal leader is elected is perceived to be entitled to certain privileges as a reward to appreciate their efforts in vote mobilization. This therefore makes local youth and women groups to largely claim ownership of the PPD kiosks and hence they take it as a business venture. Conflicts have been reported as to who is entitled to revenue collections and this has led to intra-group as well as inter-group fighting over resources collected, eventually vandalizing the PPD machines. Such a case was reported in Mabatini

ward.(KRPPD2_52:30). It was reported 5that the NCWSC takes a long time to recharge the water tanks as well as ATM cards, hence reducing the effectiveness of the technology. KRPPD2_50:00_2_53:00, "We have to persuade for water to be brought and sometimes it takes up to two weeks like now"

iv. It was reported that the political class takes advantage of the deficiencies of the technology such as lack of repair of dysfunctional tanks by providing temporary solutions as a way of youth employment, empowerment and in return earn [political support. Some of the tanks are marked in a way that it recognizes the politicians who donated them to particular groups. Most of the kiosks were found to be bearing campaign posters of politicians. Pictorials in figure 5 show different pictorials associated with PPD. Figures 5a and 5b displays political campaign materials including portraits stuck on the water kiosks. This is used to attract attention of the PPD users. In the cases of rival groups, the materials and prone to destruction. Figure 5c shows the case in which the interior part of the kiosks is converted to other kinds small-scale of businesses which are run concurrently with the water services. For instance, the kiosk is indicated that it runs M-PESA mobile banking services as well as selling of other basic commodities. Figure 5d is a closed kiosk while 5e displays a broken tank. Figures 5f and 5g show diverted water in which water is not drawn from the PPD but from illegal connection. Illegally connected water point is seen from figure 5g to be more active than that from the PPD. Figure 5h displays a youth group which is mandated to manage the water kiosk. Revenue collected by the group is meant to benefit the group members, which comprises of a few people.

v. The people in charge of the machines may not be in a good relationship with others so this bars some of the community members from using the ATM machine. For example, depending on which political divide one is perceived to belong, the opposite side may disinterest to form an association defined by the groups manning the kiosk. "You will see some people going round discouraging others from using ATM machines, they say it is dirty" (KRPPD6_17:40_2_18:22).

vi. Most of the locals are not aware of the technology though some are aware but are ignorant of the technology and its benefits. This could have been occasioned by inadequate advocacy on the technology by the service providers. ".. I have always desired to have a card, there is no one to readily available to issue cards. I was told that someone supplies them but I have never got one" (KRPPD8_04:15_2_04:38).

vii. Conflict of interest between water vendors with illegal connections and the ones at the PPD kiosks is high; as a result some machines have been reported to have been destroyed. (KRPPD5_42:00_2_47:00). "....We would recommend that the number of ATM machines be increased to reduce congestion at water points. One can queue for long at the kiosks and may give up and leave without water" (KRPPD8_09:10_2_09:25). "...In my opinion, this PPD technology cannot work in the slum. Most of the time Nairobi water do not cooperate. For you to use this card, you need money in it. But we cannot load the credit to the card by ourselves, it has to be done by someone from Nairobi water. Most of the time I call, no one comes" (KRPPD11_04:50_2_04:25). "....This technology has advantages and disadvantages. This is a slum prone to fire outbreak, tell me how you can effectively use this card to draw water to put off the fire" (KRPPD12:01:30_2_01:50).

viii.

Figure 5: Different dimensions of PPD kiosks

ix. Some respondents seemed less concerned with the lack of water in the PPDs since they mostly rely on illegally connected water. "...We really don't care too much when there is no water in this machine, the locals are also not concerned when this machines lack water because we get readily available water in pipes which are all over" (KRPPD11:07:50_2_08:15). Lack of synergy between NCWSC and the local community was reported to be part of the missing link in the PPD technology. "...If the

locals and Nairobi water can cooperate such that there is water always, then this is a good technology that can be helpful to the community" (KRPPD11_10:30_2_10:45).

4.2.4 Other findings

i. There are numerous illegal connection in Mathare valley. Water points are found to be randomly located after every a short spatial coverage.
ii. Too much water is wasted especially by water vendors with illegal connections, as water is left to flow to the drains whenever there are no clients to buy water.
iii. Theft of water tanks for the PPD kiosks by perhaps other water vendors (with illegal connections) was reported and this cripples the technology.

4.2.5 Conclusion

The technology is in place and appears to largely benefit those with the ATM cards. However, there is rebellion from some members who feel that it has become a threat to their businesses. Within the locality, there are several illegal connections which greatly interfere with the business model. The gap between the actors and the community is becoming bigger with the challenges in place.

4.2.6 Challenges faced during the research

i. Security issues- for any research to be carried out in the area, we are required to get orders from the local chief who will offer security
ii. Lack of cooperation from the locals. Some of them don't have time for the interview, some feel lazy and some would want to be paid for interview
iii. The interview guide was not suitable for most of the local water vendors.
iv. A local person was to be identified, paid to escort the field assistants to various places due to lack of security.

4.2.7 Recommendations given by the respondents

1. Repair or replacement of tanks needs to be upped.
2. The locals recommended the need to have an accessible office of the NCWSC within the locality.
3. Community involvement in the project- Mathare community members should be fully engaged in the management of the technologies.
4. The local community should be sensitized on the technology and how to use it.
5. There should be a direct supply of water to the tanks instead of depending on the water trucks.

6. Prompt action from NCWSC on matters concerning the ATMs i.e. repair, maintenance and distribution of tokens.
7. For the tanks supplied with water, there should be regular supply.
8. There should be a dialogue with the locals on how the technology can help them earn income.
9. Curbing all the illegal connections in the area would help to maximize the use of the technology
10. Installation of more ATM machines to reduce the queues when fetching water.

4.3 Case study II
Jisomee Meter (JM) Technology in Kayole

4.3.1 Abstract

The JisomeeMita(JM) , kiswahili version of “Self-reading Meter”is an innovative technology with a well thought out approach for addressing water supply and sanitation needs in most parts of Nairobi. The technology is tailored in such a way that water is connected to each household/flat where consumption rate and general control of water use is a reserve of the user. At the end of each month, the landlords/tenants are empowered to read on the meter the number of water units consumed, send this information to Nairobi City Water and Sewerage Company (NCWSC) and upon receipt of feedback message on the amount payable, they use Safaricom’s M-PESA mobile money transfer platform to pay for water bills to the NCWSC which the main water service provider in Nairobi. This arrangement is efficient and saves time and energy compared to the one in which water users have to queue in a baking hall to make water bill payments. The technology was piloted in Kayole informal settlement of Nairobi in 2014. The purpose of this study was to carry out a field survey to investigate the controversies that exist between the water provision and the local users . A total of twenty households/JM users were interviewed. 2 of the people interviewed were landlords and 18 were tenants. We noted that most of the houses/flats in Kayole are owned by a few people and most residents are tenants. Our findings were multi-faceted in a number of ways (i) the distribution of JM technology in Kayole-Soweto is fairly “good” such that approximately 3 out 5 houses/flats in the Soweto had the technology installed, although our focus was on the houses/flats installed with the JM (ii) water rationing by the NCWSC is adversely affecting the water supply, such that the residents receive water for an average of 6-8 hours a week due to water rationing. The scramble for water by the residents at the time of water supply causes injury, conflict and physical fighting among the residents, hence the technology is perceived asa “poor” venture (iii) most of the residents in Kayole live in rented houses/flats in which only one JM is installed to serve all the tenants. In this case, the landlord determines a fixed flat rate charge of between Ksh. 200 to Ksh. 500 which the tenants have to pay every month for water, regardless of the fact that water is supplied on average, 4 times a month, or none at all. This appears to be manipulative to the tenants and directly benefitting the landlord,(iv) at least 40% of the JM was dysfunctional due to vandalism and disconnection by NCWSC resulting from defaulted bills by the landlords (v) at least 20% of KR reported cases of polluted water due to contamination resulting from pipe breakage during the on-going road construction (vi) private water vending by borehole owners is still a lucrative business in Kayole despite the installation of JM technology. Residents buy water from borehole owners at an average of Ksh. 3 for a 20 litre container and some distribute using carts and sell it further through door-to- door approach at the price of between Ksh. 5 to Ksh. 20 depending on the distance covered by the vendor. This translates to between 66.67% to 500.67% profit. Water rationing, inadequate supply of water by NCWSC, high water demand and systemic failure of water systems generally provide sufficient room for water vending by private providers to thrive.

Overall, the JM technology has a great potential for maximizing water revenue collection by the NCWSC and significantly reducing the number of middle-level water vendors who make

business out of water supply challenges. This can only be plausible if three things are done:(i) increase and sufficiently maintain water piping network and guarantee water systems security (ii) provide water meters for each household in a given flat or residential area (iii) educate residents on the benefits of the JM technology and its long-term positive economic impact on household income.

This findings of this study are supported by quotes from KR. For security of the KRs, we assign identification to each respondent in the format KRJMx_mm:ss_2_mm:ss, where x is serial number of KR and mm:ss_2_mm:ss is the range of time minutes (mm) and seconds (ss) where important information is derived from audio clip..

4.3.2 Over-view of JM Technology

The JisomeeMita (JM)/Self reading meter is an innovative technology in water supply and sanitation initiative funded by the World Bank and supported by the "MajiMashinani" (Water at the grassroots) to guarantee residents of informal settlements clean and affordable water by the Nairobi City Water and Sewerage Company (NCWSC). The initiative which was launched in 2014 and piloted at Kayole-Soweto was also aimed at maximizing water revenue collection by the NCWSC, as much of water revenue is unaccounted for. Informal settlements are highly characterised by low income earners and illegal water connection by a few people who make business out of it. Hence the introduction of JM technology was to address these key socio-economic and water and sanitation challenges.

The JM technology is such that an individual is able to read the water meter at the end of the month and send the number of water units consumed to the NCWSC and gets a response with the billing information. Water bills are then paid via Safricom's M-PESA mobile money transfer platform.

4.3.3 Data Collection , analysis and Result Discussion

We had a door-to door visitation to twenty houses/flats where the JM technology is installed. We carried our face-to-face interviews on the effectiveness, challenges and opportunities brought out by the JM technology. One person identified as the representative of the rest of the tenants and interviewed from each household. Most residents of Kayole are tenants and a majority of house/flat owners live elsewhere and only come to collect rent at the end of the month. Two out of the twenty people interviewed were landlords and the rest were tenants. Questionnaire interviews were pre-prepared to aid in the data collection process and the responses from the key Respondents (KR) were recorded in a smartphone. Photos of the JM technology was also documented.

4.3.4 Technological Perspectives of JisomeeMita/Meter (JM)

Generally, a significant number of houses/flats are connected to the JM technology. Our estimation from the area we visited is that approximately 3 out of 5 houses/flats have access to JM water supply technology. It was noticed that JM technology has a great potential to solve water supply and sanitation challenges faced by the residents of Kayole. However, a number of technological, social and economic challenges still face the technology. 60% of the houses/flats visited had the JM in good state compared to 40% of the houses which had faulty, disconnected or partly vandalised JM devices. 100% of the people interviewed reported prolonged lack of water and that the NCWSC only supplied water once in a week and lasted for about 6-8 hours before it is cut off. KR reported that a number of times, conflicts have arisen in the course of scramble for water. "..This technology has many challenges. You cannot know how water bill is calculated. We are just given the bill which we have to settle in spite of not having received water for which the bill is calculated." (KRJM1_04:17_2_05:50). "Another problem is that we have to keep paying standing charges whether water is supplied or not. For example, we have not received water since last year in April to this year in April, but we have been charged standing charges of at least Ksh 170 per month" (JRJM1_05:50_2_06:47) "These meters are delicate. You will find in many plots that the meters are broken and getting spare parts is a problem" (KRJM1_07:40_2_08:10)Water rationing is largely driven by priorities. For example, public places like hospitals, schools, are given top priorities. With limited supply from Ndakaini dam, it is likely that the city's water needs are not met. This situation worsens further when the dam levels drop during dry weather conditions. Figure 1 shows the % of the number of JM devices based on their working condition. At least 20% of the KR reported that a number of pipes connected to the JM systems were suspected to have mixed with sewer line due to breakage caused by on-going road construction. The affected households had reported cases of cholera after consuming water from the JM systems. This changed the perspective of the residents toward the water supplied by the JM connection and reverted to the borehole water as an alternative, despite borehole water being salty. It had been alleged that the sewer and water supply systems lie adjacent to each other and the broken pipes necessitated mixing of waste and water hence polluting water meant for consumption. "...We have issues with this water. Sometime it comes when it is very dirty, it forces us to let the initial flush to drain away. Just next to us here, I will show you where a broken pipe is passing through the sewage " (KRJM1_12:01_2_12:39, KRJM9_01:19_2_1:25).

"....The other day, dirty water was supplied to us, also the initial meter reading is effected by pressure released upon opening for water. The cumulative monthly reading effected by pressure is counted as water bill hence hiking our water charges" (KRJM2_00:03_01:45). "Also due to low pressure, water is not pumped to other neighbourhoods yet we pay standing charges of about Ksh. 250 per month" (KRJM2_2:00_2_3:00, KRJM3_00:30_2_2:30).

It was noted that in spite of the initial desire of the technology empowering people to do do meter reading by themselves, meter reading is done by employees of NCWSC who at times are alleged to overprice (KRJM2_02:40_2_03:10). "We receive water bill that is doubtful on our side. We think that Nairobi Water feeds data into their computers and generate water bill that cannot be verified. We are imposed on paying for water which we have not consumed" (KRJM3_03:00_2_04:25).

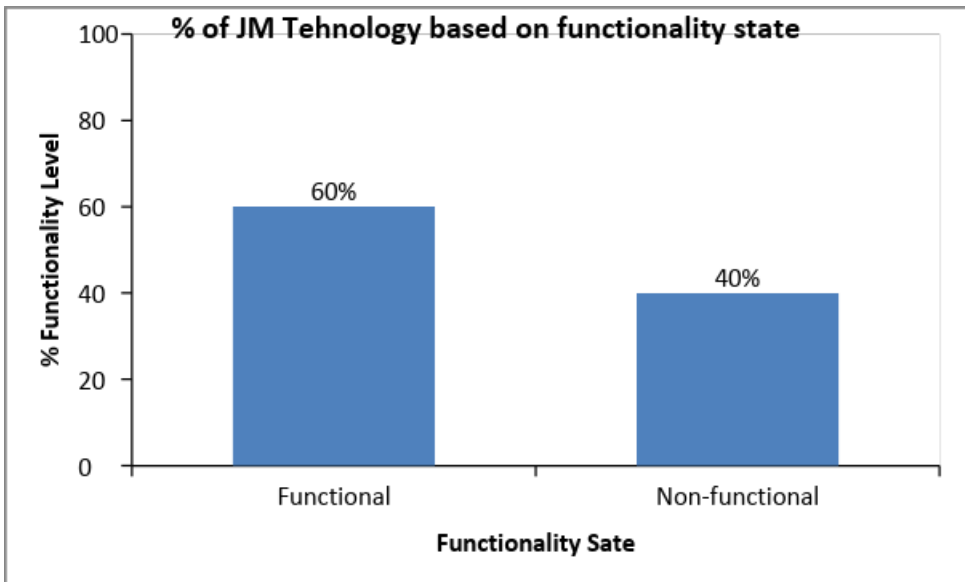


Figure 4-5: The number of JM systems based on working condition

4.3.5 Socio-Economic perspective of JM Technonology

Three flats were chosen to assess the impact of JM on socio-economic status of the residents in Kayole-Soweto. It was found out that on average; a flat consists of 10 to 20 families most of whom live in single rooms. All the flats visited had only one JM system installed to serve all the tenants. This means that the number of water units consumed by the households were not factored into by the JM systems, instead all the water bills are paid to the NCWSC by the landlord at end of each month. The landlords determine a fixed rate of between Ksh. 200 to Ksh. 500 which must be paid to him/her at the time payment of rent is done. The landlord then makes payment to the NCWSC. The most surprising finding is that the tenants pay for water at a constant rate to the landlord even at the time when the NCWSC does not supply water. This was reported by the flat/ apartment occupants whose JM systems had been disconnected by the NCWSC due to defaulted payments or the systems were partly vandalized and no meter reading was done. It is arguably possible, based on this key finding that the landlord makes business with this technology and manipulates the tenants who bear the costs of water bills with little value for money paid. Table 4.1 shows the number of tenants in the selected flats and the fixed amount of water bill paid by tenants to the landlord per month. On average, Kayole has its houses/flats rent rated at between Ksh.2,000 to Ksh. 3500 based on the internal size. With extra water bill of between Ksh. 200 to KSh. 500, the tenants pay for water at between 10% to 14.3% of the amount they spend on rent. In addition, most residents of Kayole are low income casual labourers who work for between Ksh. 150 (USD 1.5) to Ksh. 350 (USD 3.5) per day. This means that the average lowest income earner in Kayole pays for water an amount worth 1.5 day's earning in a month. This is less other basic needs like food, education, clothing and medication. This paints a picture of a society which struggles to access basic needs of a desired quality.

Table 4-1: Average amount of water bill paid by each tenants to the landlord per month

Flat No	No of rented houses within a flat	Number of JM systems installed	Amount of Water bill Paid by tenants to the landlord per month (Ksh)	Total Amount Paid by tenants to the landlord (Ksh)
Flat 1	10	1	500/=	5000/=
Flat 2	20	1	200/=	4000/=
Flat 3	11	1	500/=	5500/=
			TOTAL	**14500/=**

"Sometimes the water bill is escalated. For example, this month I paid Ksh. 1200 and I still owe Nairobi Water Ksh. 687. This technology is very expensive. I would spend Ksh. 300 on water before installation of these meters " (KRJM1_09:00_2_10_09).

Some people felt short-changed by the NWSC as they think that the treatment and services they receive from the company is different from the services they expected when signing a contract with the company. "... the way they initially communicated to us, we felt it was a good deal. When someone is luring you to something, they sound nicely..." (KRJM1_10:50_2_11:15).

"...We don't use this system (JM). Water used to come initially but we have not received water for the whole of this year" (KRJM4_0:00_2_01:10, KRJM10_0:30_2_1:25).

Other tenants reported lack of water for at least four months (KRJM6_00:00_2_00:40). "..the landlord does not live here with us. We reported this problem of lack of water but he said it is Nairobi Water taking time to supply. We are still charged water bill by the landlord even though we don't get water" (KRJM6_01:00_2_01:50, KRJM8_02:03_2_02:16).

"...Water bill was recently increased. We pay Ksh. 250 for the first 6 units and Ksh. 50 for every unit above 6. Even though we receive water once a week on every Wednesday, water bill is always served to us. I charge my tenants on behalf of Nairobi water and then pay. ....Sometimes the quality of this water is not good and we have to boil it before we use" (KRJM7_02:07_2_04:50). "...We don't know how these meters work. We are just told by the owner of the plot (landlord) to pay him water bill at the time of paying our house rent" (KRJM9_0:29_2_00:54, KRJM11_0:00_2_1:30, KRJM13_0:14_2_0:36, KRJM14_0:00_2_0:35) .

"..I have lived in this plot for two years. I have only seen water come through this system twice. I was told it was disconnected due to accumulation of water bill. The landlord charges us water bill, though he is reluctant to reconnect water. We have to use salty water from

social hall, but we buy fresh water from other landlords in different plots at Ksh. 10 for 20 litre container" (KRJM12_0:15_2_02:50).

4.3.6 Conclusion

The current JM technology is yet to meet entire needs of water supply and sanitation in Kayole and has taken long to spread the technology to other informal settlements. The technology still faces technological, social and economic challenges that are hampering its growth and backtracking on the gains already made. It is clear that water vending as a business is still lucrative and this has a negative impact on the rate of water revenue collection by the NCWSC. Prolonged water shortage that run into weeks and months provide a suitable opportunity for private water vendors who largely own water borehole to enhance the commercialization of water as a commodity and make huge profits out it. Many people expressed concerns that lack of readily available fresh water, they resorted into using salty water most of the time. Fresh water is also expensive especially when supplied by cart pushers (KRJM2_06:25_2_07:58). "..We have not received water through this system since it was installed. In other places, water comes after two weeks. We used to it..." (KRJM5_00:20_2_01:20).

Overall, our findings show that the JM technology has a great potential for maximizing water revenue collection by the NCWSC and significantly reducing the number of middle-level water vendors who make business out of water supply challenges. This can only be plausible if three things are done: (i) increase and sufficiently maintain water piping network and guarantee water systems security (ii) provide JM water metres for each household in a given flat or residential area (iii) educate residents on the benefits of the JM technology and its long-term positive economic impact on household income. In the present case where the aforementioned measures are lacking, the critical interface between the local level and key water service providers outlined in figure 2 still exists and likely to widen up in future due to increased population and water demand, increased rate of water rationing and system failures and possible hard economic future scenario.

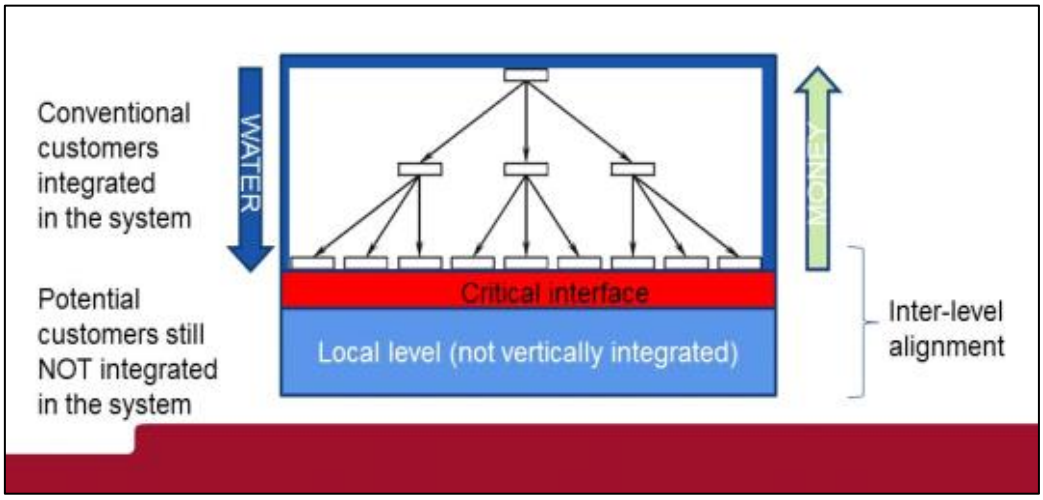


Figure 4-6: Critical interface between the regime and local level

4.4 Interviews with the Key Stakeholders in Water and Sanitation

We conducted interviews with the following stakeholders to find out on their role in the aforementioned two technologies:

i. Nairobi City water and Sewerage Company (NCWSC)
ii. Nairobi City County (NCC)
iii. Water Services Regulatory Board (WASREB)

Since our interview with these key stakeholders lumped the two technologies together, we combine our reporting to infer to both technologies, unless specified otherwise. We report the responses herein using unique codes as KR_NCWSC_mm:ss_2_ mm:ss, KR_NCC_mm:ss_2_ mm:ss and KR_ WASREB _mm:ss_2_ mm:ss for NCWSC, NCC and WASREB respectively.

4.4.1 Interview with the NCWSC

We were given a brief background of the two technologies where we were informed of the pilot period of PPD between 2015 and 2016. At least 200 PPDs were installed between 2015 and 2016. Currently, 800 PPD machines are reported to have been acquired and the installation is underway in various informal settlements in Nairobi (KR_NCWSC_02:30_2_ 03:34). The JM technology was started in 2015 with the focus on informal settlements. By the time of this interview, six informal settlements had been covered,(KR_NCWSC_03:35_2_05:53). The concept of JM was motivated by the need to assist the informal settlement residents to avoid water bill accumulation (KR_NCWSC_05:58_2_ 06:30) by self reading the meter and paying 5the bill via mobile platform at their convenience. It was reported that acquisition of PPD token cost Ksh. 50 (KR_NCWSC_07:18_2_ 07:28). The company has a machine that assists the customers to load the tokens (ATMs) using their regional offices (KR_NCWSC_07:50_2_ 08:15). The customers of JM were to pay for water meters as well as sewer line at a cost of Ksh. 1649. The connection of sewer is charged Ksh. 27000 and water is Ksh. 36000. These amounts are advanced by the company as loan to be paid for a period of 36 months. The monthly loan repayment for water is ksh. 150 while for sewer is ksh. 450 (KR_NCWSC_10:20_2_ 11:15). The contract for JM is done between the individual and the company while PPD is communal but it can also be acquired by an individual (KR_NCWSC_12:08_2_ 12:50). For the PPD , the company with WASREB's approval sets the tariff which the vendor implements at ksh. 0.5/20L (KR_NCWSC_13:38_2_ 13:47). These technologies were adopted so as to make water available at affordable cost

(KR_NCWSC_15:00_2_15:30). Contrary to the majority of the respondents in PPD, it was reported that community participation was done using sociologists who informed the community about the project before it was implemented. Other community leaders from political and administrative fronts were also informed (KR_NCWSC_16:25_2_ 17:10). The provision of PPD is based on the levels of need and also the structural and dynamisms of the settlement. (KR_NCWSC_18:00_2_ 18:59). Landlords with formal land ownership rights are given their own PPDs or JMs which they can use to serve water to the tenants (KR_NCWSC_19:00_2_ 19:57).

A number of challenges were reported to be frustrating the two technologies. For instance water cartels who vend water through the illegal connection are opposed to the technology and they cause vandalism especially on PPDs. The community is also resistant to the technology. Political interference was reported as some politicians wanted to claim projects as their initiatives. Lack of space for installing the PPD machines is a major challenge. The Nairobi water staff also face insecurity as they are threatened when they patrol to take meter readings, so that their obstruction would necessitate failure of remittances of money to NWCSC.. Theft of solar meant to supply power to the PPD was reported (KR_NCWSC_21:00_2_ 25:34).

Some leaders of CBOs were reported to have sold the tanks issued by the company , rendering the PPD unusable (KR_NCWSC_52:40_2_ 53:15). Some inter-group rivalry, cartels' business insecurity and vandalism was reported to be the cause destruction of some of the PPDs and water tanks (KR_NCWSC_53:00_2_ 54:25). The company was aware that some of the PPD tanks were leaking but was hesitant to replace those perceived to have been intentionally damaged (KR_NCWSC_54:47_2_ 55:45).

These challenges play a significant role at the critical; interface, which tend to widen the interface.

The company resorts to social interventions such holding of public meeting (commonly known as Barazas) to educate the public on the need to protect these infrastructures (KR_NCWSC_26:00_2_ 26:25). Although the company is satisfied with the results of these technologies, it intends to do a monitoring and evaluation exercise to assess the impact these initiatives have on the communities (KR_NCWSC_27:30_2_ 28:38).

While PPD was easy to do revenue collection by virtue of ATM being a prepaid platform, JM were reported to have certain challenges occasioned by non-willingness of the contract holder to pay the company (KR_NCWSC_34:00_2_ 34:50).

It was reported that these technologies are very resource intensive and sustaining them would require more organizations to partner with the company. For instance, to install the 800 PPDs, the company requires Ksh. 154M, but the county government , in spite having a budget line for water services in Nairobi, doesn't support the company on grounds that the company generates enough money for its needs (KR_NCWSC_34:00_2_ 38:50).

It was reported that the company was finding it difficult to penetrate into the informal region and convince the public on the technologies (KR_NCWSC_39:30_2_ 40:00).

It was reported that for every PPD, 150 ATM cards are issued (KR_NCWSC_43:00_2_ 43:25). With this projection, it is estimated that by the time all the 800 PPDs are installed, about 120,000 ATM cards will have been issued.

It was reported that the company relied on the willingness of the end PPD users to show interest in using the cards and loading it when in need of credit. Failure of the public to request for assistance to load the card was making their cards remain unused (KR_NCWSC_47:30_2_ 48:15). Complaints of dirty water by the users were not reported to the company. The company instead finds these allegations as malicious, propagated by water cartels who discourage the public from using the two technologies and eventually promote their water vending business. Other tricks used by the cartels to scare people from acquiring the cards are that people would be "traced" by the government when they possess a card, (KR_NCWSC_50:14_2_ 52:15). Arguably since card holders submit their identification details.

Resistance by the people to give personal details was a key deterrent to the issuance of the two technologies (KR_NCWSC_58:00_2_ 59:59).

4.4.2 Interview with the NCC

Common problems facing the two technologies as earlier alluded to by NCWSC such as cartels, insecurity , lack of land to install PPDs were also reported by the County government (KR_NCC_05:45_2_07:10) . The county government is improving lighting in the informal settlements to curb insecurity, it plan to installthe PPDs in public institutions such as schools and using county security officers to monitor activities of water selling by cartels (KR_NCC_07:30_2_08:30). The county government is also planning map out areas that require installation of the PPDs (KR_NCC_08:50_2_09:15). The general perception about water by the public is that water is free, and clan water is being used in other parts of Nairobi to wash cars (KR_NCC_11:30_2_13:05), thereby increasing the cost of water service provision.

The county government is finding it difficult to which extent the public participation in the technologies should be reached (KR_NCC_18:45_2_19:30). It was reported that lack of inter-agency co-ordination was hampering the success of te technology. For istance, gains made by one agency such as NCWSC in doing water piping is destroyed by the works of another agency such as road construction authority that destroy water pipes initially laid (KR_NCC_20:00_2_21:40, (KR_ WASREB _33:00_2_34:45). The county appreciates that some cases of water over-pricing has been reported before but the cases have been minimized (KR_NCC_28:00_2_29:00).

.

4.4.3 Interview with the WASREB

WASREB as a regulator ensures efficiency and uniform standards of water services which protect the water consumer through regulatory tools (KR_ WASREB _01:00_2_2:30).

It was reported that the two technologies faced certain challenges that make it difficult to do regulation. For example, the cost of software maintenance is high and the backup system and repair needs to be imported from other countries. The technologies are also vulnerable to poor water quality (KR_ WASREB _07:20_2_8:15). The regulator noted that the JM technology users reported complaints of water overpricing but it is impressing the technologies, though on pilot basis (KR_ WASREB _09:00_2_9:45). The WASREB does not play a role in the design of the technology but on price regulation. It controls the number of machines supplied, ATM cards issued and the price, but on the pilot level at the moment (KR_ WASREB _16:00_2_17:30). Vandalism was reported to have occurred at certain areas where PPDs were

destroyed (KR_ WASREB _38:00_2_38:25). The reason for vandalism was alluded to cartels who felt their water business threatened and wanted to do away with the PPDs (KR_ WASREB _39:11_2_39:45). Lack of land ownership rights and insecurity was also alluded to by WASREB as the main threat to PPDs (KR_ WASREB _40:50_2_41:15). WASREB said that it was aware of the exploitation of tenants by landlords but recommended awareness creation to the tenants on water utility and billing ((KR_ WASREB _55:30_2_56:30). It was reported that some people from middle income levels intruded the informal settlement to draw water at much lower prices of Ksh 0.5 and sold or used it elsewhere (KR_ WASREB _58:00_2_58:53).

4.5 Results from NCWSC Data: Quantitative Analysis for Performance of PPD in Mathare

4.5.1 Amount of water supplied, Revenue collected and Number of ATM cards issued

NB- analysis presented here is based on preliminary data obtained from NCWSC. During follow-up discussions in November 2018 it has been realised some inconsistencies in the data especially for the period Jan-June 2018. In anticipation of updated datasets from NCWSC the analysis and conclusions presented below should be regarded as provisional.

From the preliminary data, trend analysis in figure 4-7 shows that a sharp decrease exists in the amount of water supplied to Mathare and accounted for by the NCWSC between January, 2016 and June 2018. This is arguably due to high rate of rationing and high rates of illegal water connection. With about 6 million litres of water supplied in two and half years, it shows that Mathare with a population of approximately 200,000 people shows that only about 30 litres per person is accounted for in one and half years. This is impossible and hence, there is evidence of insufficient supply of water through PPD in Mathare. Our interviews suggest that at least 60litres of water is used per day in a household of three. This therefore means that too high rates of non-revenue water in Mathare still exist in spite of technological advancement in water and sanitation services.

Decreasing trend is also noted in the revenue collection as depicted in figure 4-8. In addition, figure 4-9 shows that less than 1500 ATM cards have been issued in the last one and a half years. This shows that the uptake and appreciation of the local communities in the establishment of technology in water supply is low. This creates a gap which is potentially manipulated by the local water service providers. Our interaction with the NCWSC found that the ATM cards were initially charged Ksh. 300 but it is now issued free of charge. However, there seems to be a communication gap between the local communities and the NCWSC on the same.

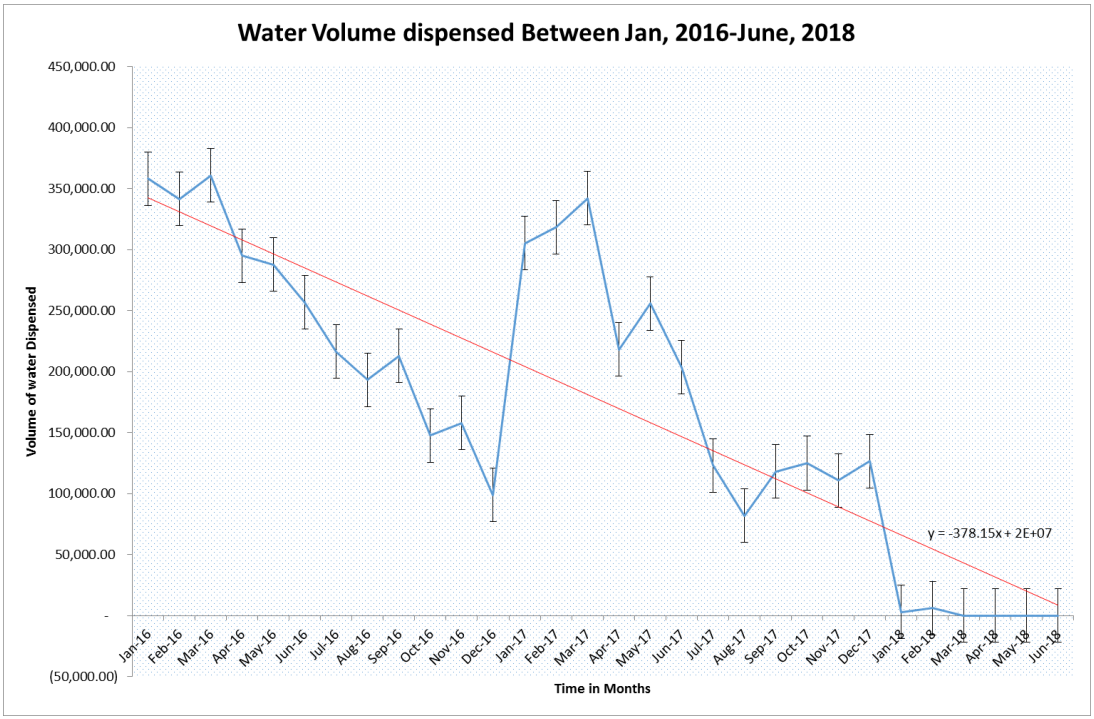


Figure 4-7: Trend of water volume supplied (litres) between Jan, 2016-June, 2018

Figure 4-8: Trend in water revenue collection between Jan, 2016-June 2018

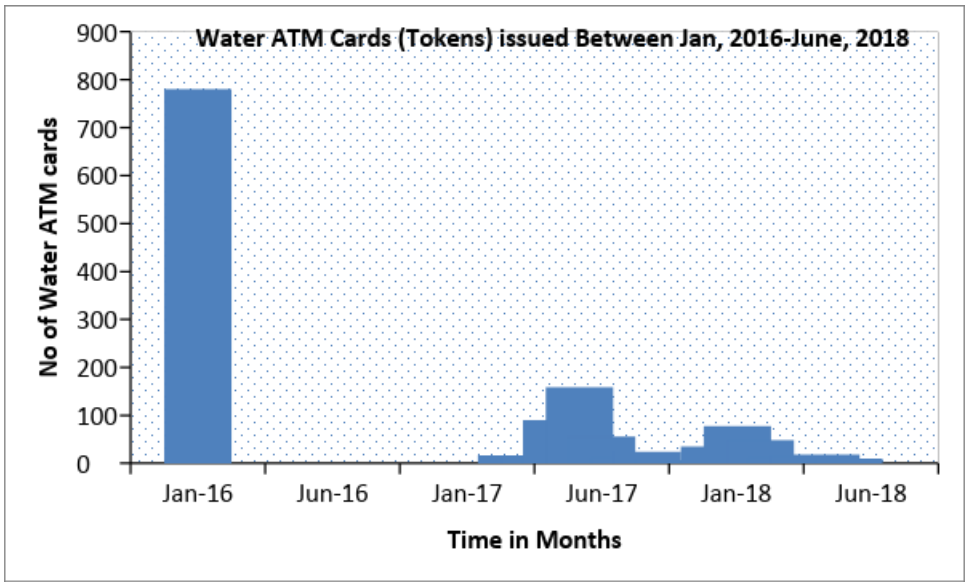


Figure 4-9: Number of water ATM cards (tokens) issued between Jan, 2016 to June 2018

Figure 4-9 shows that there was no uptake of water ATM cards in most of 2016. Improvement of issuance of cards was evident in 2018, although in a declining trend towards 2018. January 2016 recorded highest uptake of cards. It seems that the preceding years towards 2016 had a good uptake of ATM cards. But again, it would be expected that the uptake would be much more at the time when the cards are issued at no cost than at the prior period when the card would be charged Ksh.300, an amount that perhaps made potential beneficiaries to shy off.

If empirical data suggest a decline in water supply through PPD as well as in water revenue collection, then it can be argued that the controversies are still “real” and not easily mitigated. This is in support of the observation made in the field survey.

4.5.2 Quantitative Analysis for Performance of JM Technology in Kayole

Figure 4-10 shows a comparison between the amount of money billed (in Ksh) for water supplied and the amount of money paid (Ksh.) for the period Jan, 2016 to June, 2018. It is noted from figure 4-13 that at least 36.64% of money billed is defaulted. The number of customers with active JM billing accounts stands at between 150 to 800for the same period as depicted in figure 4-12. From figures 4-11 and 4-13, it is noted that the amount of water supplied to Mathare for the period of 2.5 years is approximately 952,000m^3. With a population of about 150,000 people, it shows that only 6.35m^3 per person was supplied between Jan, 2016 and June, 2018. In the face of this water deficit, figure 4-10 shows continued increase in billed charges made by NCWSC. This suggests a disconnect and justifies the concerns by the local communities in which they are charged even during periods for which water is not supplied.

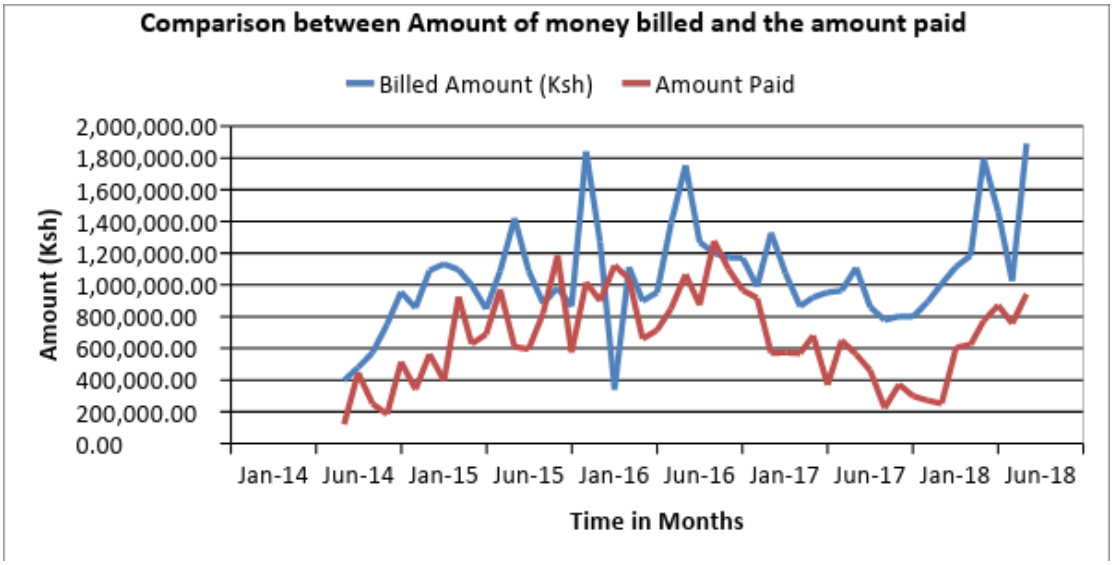


Figure 4-10: Comparison between the amount of money billed (Ksh) and the one paid (Ksh) between Jan, 2016 to June, 2018

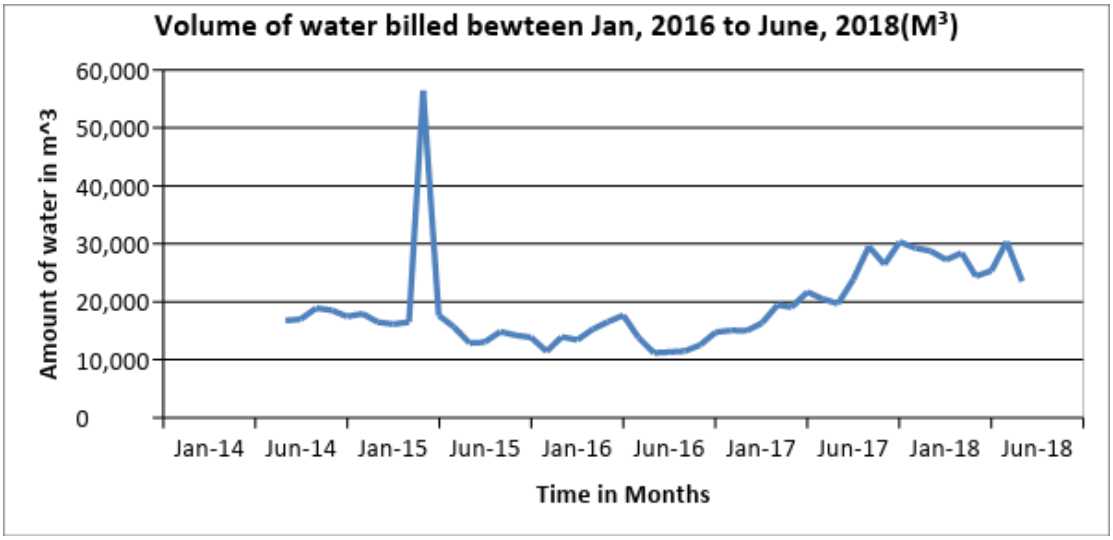


Figure 4-11: Trend of the volume of water billed between Jan, 2016 to June, 2018

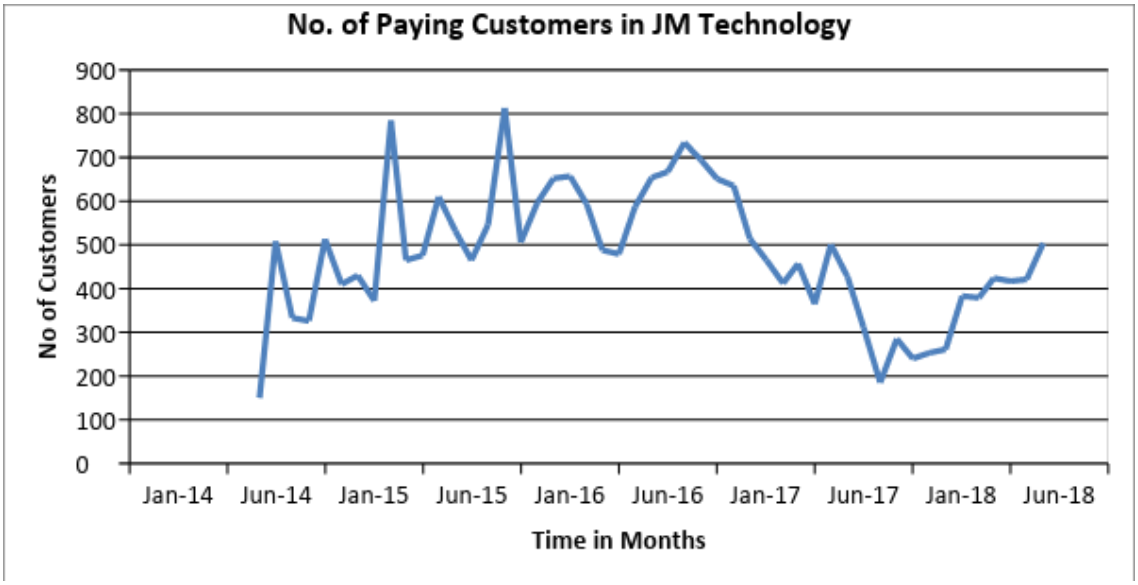


Figure 4-12: Trend in the number of active water customers between Jan, 2016-June, 2018

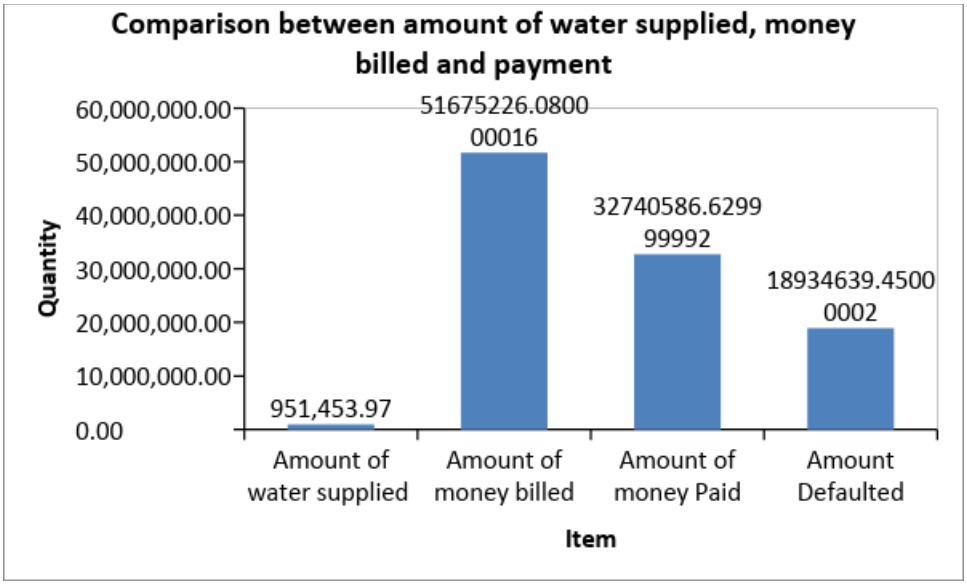


Figure 4-13: How much water is supplied, money is billed, paid and defaulted between Jan, 2016 to June, 2018?

Analysis from the data supplied by the NCWSC largely shows that a lot of challenges in water supply and maximum revenue collection still exist. Hence, there is an agreement between the views of the KR in the interview at the local level that PPD and JM technologies are yet to fully address the water and sanitation challenges of the informal sector. Many controversies within the broadening critical interface prey on Illegal Water Connection (IWC) and deliberate occasioning of systemic failures of the technological efficiencies, thereby dampening the ability of local communities to directly get water from NCWWSC through Legal Water Connection (LWC). This makes it difficult for the NCWSC to carry out Direct Revenue Collection (DRC). The net effect is the potential increase of water cost on the local community, increase the rate of Complete Uncounted Revenue Collection (CURC), decrease the rate of as well as denying the NCWSC to maximize water revenue collection.

Appendix

Appendix 1: A list of the PPD water kiosks vited

CODE	NAME	WARD	LATITUDE	LONGITUDE	GROUP	FUNCTION	AREA
1	Mabatini Kiosk 1	Mabatini	-1.26947	36.85681	MathareMashimoni self-help group (Adults)	Functional	Mabatini
2	Mabatini kiosk 2	Mabatini	-1.26173	36.85861	EnlightersMashimoni self-help group(Youth)	Rarely functional (no water supply)	Mabatini
3	Mabatini kiosk 3	Mabatini	-1.26197	36.86148	Harmony Community Based Organization (Women)	Functional	Mabatini
4	Village 2 kiosk 1	MlangoKubwa	-1.26464	36.85246		Functional	Village 2
5	Village 2 kiosk 2	MlangoKubwa	-1.26575	36.85139		Functional	Village 2
6	Village 3B kiosk 1	MlangoKubwa	-1.26494	36.85246	Community Health Education Group(Adult)	Functional	Village 3B
7	Bondeni Kiosk 3	Mabatini	-1.264	36.85495	Tears single Mothers Women Group(Widows)	Non-functional (piping and no water supply)	Bondeni
8	Bondeni Kiosk 2	Mabatini	-1.26433	36.85583	Tung'ang'ane Self-help group (Adults)	Functional	Bondeni
9	Bondeni Kiosk 1	Mabatini	-1.26947	36.85681	Mathare Women Development Organization(Mixed adult group)	Functional	Bondeni
10	Village 3C kiosk 4	Mlangokubwa	-1.26443	36.85827	MatharePamoja Self-help group	Non-functional (Leaking tank)	Village 3C
11	Village 3C kiosk 3	MlangoKubwa	-1.26473	36.85904	Men and Women self-help group	Non-functional (Leaking tank, piping)	Village 3C

12	Village 3C kiosk 2	MlangoKubwa	-1.26385	36.85928		Non- functional (vandalism of ATM machine)	Village 3C
13	Village 4B kiosk 3	Hospital	-1.26346	36.85801	Konyrikendi self-help group	Non-functional (residents know no cause)	Village 4B
14	Village 4B kiosk 2	Hospital	-1.2632	36.85688	Imara self-help group	Functional (Has a tank that leaks to a certain level)	Village 4B
15	Village 4B kiosk 1	Hospital	-1.26355	36.85594	Pull-together self-help group	Non- functional (no water supply)	Village 4B
16	Kosovo kiosk 1	Hospital	-1.26252	36.84947		Non-functional (no water supply)	Kosovo
17	kosovo kiosk 2	Hospital	-1.26257	36.85805		non-functional(no tank, solar, ATM not working)	Kosovo
18	kosovo kiosk 3	Hospital	-1.26258	36.85162		Functional	Kosovo
19	kosovo kiosk 4	Hospital	-1.26277	36.85372	River-jump self-help group	Not functional since installation(no water supply)	Kosovo
20	Gitathuru Kiosk 4	Hospital	-1.2622	36.85481		Functional (leaking tank)	Gitathuru
21	Gitathuru Kiosk 3	Hospital	-1.26186	36.85446	Tuamuka self-help group	Functional(no water supply)	Gitathuru
22	Gitathuru kiosk 2	Hospital	-1.26104	36.85366	Omega self-help group	Functional	Gitathuru
23	Gitathuru kiosk 1	Hospital	-1.26053	36.85365	Gitathuru Business Women Group	Functional (no water supply)	Gitathuru
24	Village 3C	MlangoKubw	-1.26569	36.85744		Functional(no tank	Village 3C

	kiosk	a				since installation)	
25	Village 3A kiosk	MlangoKubwa	-1.26496	36.85752	Muungano group	Functional	Village 3A
26	Village 3B kiosk	MlangoKubwa	-1.26563	36.85495	Village 3 self-help group	Non-functional (Problem with the ATM)	Village 3B
27	Village 3B kiosk	Mlangokubwa	-1.2656	36.85336	PMTC(Women)	Functional	Village 3B
28	Village 3B kiosk	Mlangokubwa	-1.26574	36.8522		Non-functional(broken tank)	Village 3B
29	Kiamtisya kiosk 2	MlangoKubwa	-1.26296	36.84551	Muunganowakiamtisya	Functional	Kiamtisya
30	Kiamtisya kiosk 1	Mlangokubwa	-1.2621	36.84634	Muungano group	Non-functional since installation(piping, no water supply)	Kiamtisya

Appendix 2: Interview Guide/ Mwongozowamaswali

DISTRIBUTION TECHNOLOGY/ TEKNOLOJIA YA USAMBAZAJI	BUSINESS MODEL/ MFANO WA BIASHARA
How would you describe your level of influence over the technology, its design? Je, ungeeleza vipi kiwango chako cha ushawishi kuhusu teknolojia hii, muundo wake? How do you influence the design and detailed setup of the PPDs/ jisome in concrete terms?	How can your organisation influence the business side of the innovation: the price, the payment model, enforcement mechanism etc? Shirika lako linawezaje kuathiriupande wa biashara wa mfumo huu wa teknolojia: kwa bei, mfano wa malipo,utaratibu wa utekelezaji?

Je, ni vipi unavyo athiri jinsi ya kubuni na kuanzisha yeknolojia hii kwa maneno halisi?	
How would you describe the distribution technology? Tueleze kuhusu mfumo huu wa teknolojia ya kusambaza maji?	How will the innovation affect cost recovery and revenues for your organisation? How will it profit your organization? Mfumo huu utaathiri vipi kupata pesa na faida kwa kampuni yenu? Je, itakua na faida zozote kwa kampuni yenu?
What is your regular mode of water provision? Njia yenu ya kawaida ya kupata maji ni gani? What is new with this technology compared to regular mode of provision? Wawezaje kulinganisha njia ya kawaida ya kupata maji na huu mfumo mpya wa kusambaza maji?	How are prices for the customer controlled?/ What informs the water price for the end user? Je, Bei za wateja zinadhibitishwa vipi? Je, ni nini kinachojulisha bei ya maji kwa mteja?
Where did the initiative start? Who was behind the introduction of this project? How did the initiative develop? How has this technology helped to improve sanitation and water quality? Mpango huu ulianza wapi? Nani alikua msimamizi wa kuanzishwa kwa mpango huu? Mpango huu uliendelea vipi? Teknolojia hii imesaidia vipi kuboresha ubora wa usafi na maji?	What problems have you seen in terms of the revenue collection?What are the weak links in revenue streams?How do you address this? Je, ni matatizo gani umeona kulingana na ukusanyaji wa mapato? Ni viungo gani dhaifu katika mito/njia ya mapato? Je, unayahughilikiaje haya?
What are the most difficult challenges or obstacles from the	What problems do you see in terms of financing the PPD / jisome?

technology point of view? Je, mfumo huu wa teknolojia una changamoto au vikwazo gani?	Je, ni shida gani unaona ukizingatia upande wa kifedha katika teknolojia hii ya PPD/Jisomee? How have you dealt with these problems? Ni vipi mnavyosuluhisha shida hizi?
How did you solve these obstacles? Please give examples if you can. Je, mlisuluhisha vipi vikwazo hivi? Tfadhali tupe mifano	Are there any legal or political problems with PPD / the jisome? Je, kuna shida zozote zinazotokana na sheria au siasa katika mfumo huu wa teknologia ya PPD/Jisomee?
Which are the most important actors to interact with? Why are they important? Ni kina nani wahusika wakuu ambao ni muhimu sana wa kuingiliana nao? Kwa nini unawachukua kama watendaji muhimu?	How do you think that PPD / jisome affects your overall business, in the long and short term? Ni vipi mfumo huu wa teknolojia ya PPD/Jisomee unaathiri biashara yako? Kwa sahii na ata wakati ujao?
In what geographical areas have you tried these technologies? Why these areas? Teknologia hii imejaribiwa katika maeneo yapi ya kijiografia? Mbona maeneo haya?	What are the main risks for financial viability? Je, mfumo huu una hatari gani kwa ufanisi wa fedha?

What do you think is the most interesting development potential of the PPD / the jisome in the near future? Je, unafikiri ni maendeleo gani ya kuvutia yatakayoletwa na mfumo huu wa teknologia ya PPD/Jisomee kwa wakati ujao?	What kind of organisational changes has the PPD / jisome model necessitated? Ni aina gani ya mabadiliko ya kishirika yaliyoletwa na teknolojia hii ya PPD/Jisomee? New units/branches, delegation, customer service, new competence needed etc? Vitengo na matawi mpya, kuongezeka kwa vitengo vya huduma kwa wateja, kuhitajika kwa wakazi wapya?
With regards to the technology, what are the most pressing challenges/obstacles when it comes to policy or regulation? Je,ukizingatia teknolojia hii, ni changamoto gani kubwa inayotokana na sera au kanuni? Are there documentation and reports that you could share with us? Je, kuna nyaraka zozote au ripoti ambazo unaweza kutuazima?	With regards to the business side of the PPD/jisome, what are the most pressing challenges/obstacles when it comes to policy or regulation? Je,ukizingatia upande wa biashara wa teknolojia hii ya PPD/Jisomee, ni changamoto gani kubwa inayotokana na sera au kanuni? Are there documentation and reports that you could share with us? Je, kuna nyaraka zozote au ripoti ambazo unaweza kutuazima?

`

Appendix 3: The Technological, Economic and socio-political aspects of the PPD Technology

TECHNOLOGICAL	ECONOMIC	SOCIO-POLITICAL
Broken tanks	The PPD technology is acts like a business venture for groups who make more than 900% profit	Conflict of interest on who to man the PPD kiosks (internal conflict) as well as between the technology and individual water venodors with illegal water connection.
Vandalism of ATM machine	Low Revenue collection by the NCWSC	Competition between the individual water vendors

		and the ATM handlers keep the costs of water unstable
Machine breakdown	Lack of readily available ATM credits for easy access by the local communities	Ignorance of te residents on the benefits of the technology
Lack of readily available water ATM cards		Fear of disclosure of KRA pin and ID cards due to political reasons and desire to avoid in paying tax.
Unreliable water supply		Illegal connections is rampant
Competition between individual water vendors and the PPD water kiosks		Lack of community engagement in the installation of the technology
Poor piping system		Lack of monitoring
Lack of maintenance and repair of breakages and replacing broken water tanks		Poor sanitation due to lack of maintenance of the the PPD systems
Lack of awareness on how to use the technology		Politicians promoting distributing water tanks to individual water vendors and neglecting PPD due to political reasons
Illegal connections		Illiteracy is high and local community are afraid of facing the challenges of the PPD technology and its use
Lack of local offices for the management of the PPDs		Misperception that buying of water at Ksh. 0.5 is meant for the “poor”, hence the price of ksh. 5 “elevates” ones’ economic status perception in the society
Unreliable water supply by the NCWSC		

Appendix 4: List of the Key Respondents (KR)

SN	Interviewees	Occupation	Use ATM Card	Location/Ward
KR1		Tailor and PPD water ventor	YES	MABATINI
KR2		Sociologist working NCWSC	YES	MABATINI
KR3		Water vendor-illegal connection	NO	MABATINI
KR4		Business man	NO	MABATINI
KR5		Business lady	YES	MABATINI
KR6		Social worker	YES	MABATINI
KR7		Tailor	YES	HOSPITAL
KR8		Community leader	YES	MLANGO KUBWA
KR9		Youth	NO	HOSPITAL
KR10		Business man	YES	HOSPITAL
KR11		-	NO	HOSPITAL
KR12		-	YES	MLANGO KUBWA
KR13		-	YES	MLANGO KUBWA
KR14		Business man	NO	HOSPITAL
KR15		Business man	YES	HOSPITAL
KR16		-	NO	MLANGO KUBWA
KR17		-	YES	MLANGO KUBWA

Appendix 5: Number of Houses/Flats visited with the JM systems installed

House/Flat	Functionality Status of JM
1	Functional
2	Functional
3	Functional
4	Functional
5	Functional
6	Non-functional
7	Non-functional
8	Non-functional
9	Functional
10	Functional
11	Functional
12	Non-Functional
13	Functional
14	Functional
15	Non-functional
16	Non-functional
17	Functional
18	Non-Functional
19	Functional
20	Non-Functional

Appendix 6: Pictorials of PPD and JM Technologies in use