Experiences with Pre-Paid Dispensers

LESSONS FROM THREE KENYAN CITIES
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Experiences with Pre-Paid Dispensers:
Lessons from Three Kenyan Cities

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Summary of Take Away Messages

- Installing PPDs may not only respond to the objective of ensuring cost recovery when extending services, PPDs can also be used to limit consumption and alter the water supply chain for existing connections by removing intermediaries such as kiosk operators, landlords or cartels.

- The PPDs are part of an infrastructure system (condition of the network, water pressure, water availability, etc.) and a social system (involving intermediaries and consumers). It is important to analyse how such a dispenser fits within the technical and social systems.

- It is important to ensure that usage of the PPD adheres to its design specifications. Improper use can lead to breakdowns.

- There is a need for a back-up system for water supply to ensure that breakdowns of the PPDs do not immediately lead to consumers being cut-off.

- The installation of PPDs may come with additional requirements in terms of capacity and resources for maintaining and repairing the dispensers. Not acknowledging these costs in the decision to install PPDs can lead to a large number of PPDs becoming non-functional.

- Decision making on the introduction and use of PPDs needs alignment of the interests, objectives and expectations of all stakeholders (donors, users, policy makers, water operators, etc.) to ensure long lasting performance.

- The introduction of PPDs will impact the interests of various intermediaries. It is important to have a good understanding of how these interests will be affected and how that may influence the positioning, operation and functioning of PPDs.

- Do not ignore the need for (additional) human capacity and financial resources to operate, maintain, repair and replace PPDs. If not planned for, it may rapidly result in breakdowns of the PPDs.

- The after-sale service provided by PPD supplier is a major factor affecting the cost effective and sustainable use of PPDs. This service includes technical repair, provision of spare parts, as well as software updates, and distant IT support.

- In thinking about PPDs there is frequently a confusion of the potential of PPDs and the actual experiences with PPDs. The potential benefits of PPDs are still appealing even if actual experiences are less successful.

- PPDs can be presented as a cutting-edge technology that instils prestige in a water utility. Although unrelated to actual service provision of the water utility, such prestige does matter in the community of water service providers.
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Introduction

The use of pre-paid dispensers (PPDs) for distributing water services to low-income areas in Sub-Saharan Africa has increased considerably since the 1990s (Heymans et al., 2014). The use of this technology has, however, not been without controversy. On the one hand, potential benefits and advantages of the technology target the consumers and the water utility, and mostly relate to ease access and costs. Pre-paid dispensers are viewed as improving access because they function 24 hours a day, allowing the consumer to fetch water on demand. The consumer is not dependent on a kiosk operator for accessing water (Heymans et al., 2014). Benefits related to costs mainly entail the absence of an intermediary (such as the kiosk operator) and the avoidance of piled-up bills. The consumer knows at all times how much credit is left for purchasing water and can manage water use to accommodate that situation (Heymans et al., 2014). Pre-paid dispensers can benefit the water utility as it allows them to extend water services to consumers without compromising cost-recovery (Hanjahanja, 2018; Schwartz et al., 2017; Boakye-Ansah et al., 2019). The “pre-paid water meter is capable of both measuring the volume of water used, and obligating water users to pay for water” (Berg and Mugisha, 2010:595). By controlling both volume dispensed and payment, the pre-paid dispenser is presented as “the ultimate cost-recovery tool” (Berg and Mugisha, 2010:589). In achieving cost-recovery, the technology of the pre-paid dispenser removes utility staff as an intermediary between the dispensing point and the consumer. This is seen as advantageous as it cuts administrative costs and transforms the (political) relationships between the water utility and the consumer (Berg and Mugisha, 2010:595).

On the other hand, the use of PPDs has been criticized as it exemplifies the commodification of water services. In this perspective “the daily indignity and inhumanity” is highlighted that consumers who have to access water through pre-paid dispensers need to endure (Bond and Dugard, 2010:1). Pre-paid dispensers, which essentially cut off service for consumers if they have insufficient credit, are argued to represent a barrier to achieving the human right to water (Mirosa and Harris, 2011). PPDs are seen as forcing consumers to become “calculative agencies, to optimise the household’s consumption behaviour and to become economising factors” (von Schnitzler 2008: 916). Rather than a tool that promotes agency of the consumer, it thus becomes a tool that constrains such agency.

In this report it is not our purpose to engage in a discussion or debate with either of these two sides of the debate. Instead we seek to contribute and facilitate the decision-making process of utilities concerning PPDs. We examine experiences with the installation and operation of pre-paid dispensers. By trying to understand how pre-paid dispensers are used and function in practice we hope to provide a basis that allows practitioners to reflect on their own ideas regarding the desirability of using pre-paid dispensers.

1. In this document we use the term pre-paid dispenser (PPD) as much as possible. However, the term is at times interchangeable with pre-paid meters (PPM) as much of the literature on this technology refers to meters instead of dispensers.
We do this by examining three case studies where water utilities installed and operated pre-paid dispensers in the Kenyan water services sector: Kisumu, Nakuru and Nairobi. The Kisumu Water and Sewerage Company Limited (KIWASCO) and the Nakuru Water and Sanitation Service Company (NAWASSCO) are part of the Performance Enhancement of Water Utilities in Kenya through Benchmarking, Collective Learning and Innovative Financing (PEWAK) Project. Nairobi City Water and Sewerage Company (NCWSC) is engaged in a water operator partnership with the Dutch water utility Waternet under the WaterWorX Programme. These connections allowed for the authors to have access to information regarding these cases and facilitated the arrangement of interviews and field visits to develop this report. Fieldwork for this report was undertaken from April 29th until May 10th, 2019. In addition to interviews with staff at the three water utilities and site visits, interviews were also conducted with the Water Services Regulatory Board (WASREB), the Water Sector Trust Fund and a supplier of pre-paid dispensers (Maji Milele).

By focusing on (only) these three cases, the report also has inherent limitations. Pre-paid dispensers come in a variety of sorts, with very different specifications and associated costs. Problems observed with respect to particular PPDs in the three cases may have been case specific and/or specific to that particular dispenser and may not be easily generalized to all PPDs.

In this report we first present the main findings and conclusion from the three cases. The elaborated case studies of these three locations, with the more detailed findings from each case, are presented in the annexes.

Lessons Learnt

In this document we highlight lessons learnt from the installation and operation of pre-paid dispensers in Kisumu, Nakuru and Nairobi. These lessons stem from the case descriptions. The full description of the cases can be found in the annex.

The Purpose of Introducing Pre-Paid Dispensers

Pre-paid dispensers (PPDs) are often promoted and offered to water utilities as solutions to expand services to low-income areas in settings where the consumers’ ability to pay is a concern to the water utility. PPDs are attractive solutions to water utilities because consumers benefit from ease of access (24/7 access) and the utility can extend services without compromising cost-recovery. Furthermore, PPDs are of relative low technical complexity, easy to install, operate, and maintain. The reasons for installing PPDs in Kisumu, Nakuru, and Nairobi, however, diverged from the ’standard’ description of extending services without compromising cost-recovery. All cases share that the installation of PPDs had the specific purpose of removing the intermediaries between the water utility and the user.

In the case of Kisumu, the installation of PPDs was a first step towards phasing out kiosk operators managing existing standpipes. By replacing kiosk operators with PPDs, kiosk operators would have less opportunities to exploit consumers. In Nakuru, low-income areas are typically organized as gated plots where tenants rent small dwellings from landlords. In these gated plots, tenants access
water from standpipes and/or water connections, which are controlled by the landlord. The PPDs were viewed as a tool for managing the relationship between the landlord and the residents. With the installation of PPDs the landlord no longer acted as intermediary between the consumer and the water utility, and did not have to include costs for water in the rent charged to residents. This relieves the landlord from the effort of having to recover costs for water consumed by residents. At the same time, it also safeguarded the residents from possible exploitation by the landlord (who may charge excessively for access to water). For residents it would have the additional benefit of being able to access water whenever they wanted.

In Nakuru, the water price charged at these PPDs is lower than that of kiosks. In the case of Nairobi, the use of pre-paid dispensers is strongly linked to the utility’s attempts to reduce non-revenue water and break the control of cartels in the city’s low-income areas. Nairobi City Water provides water at a price of 0.5 KES per 20 litres (below cost-recovery) via PPDs installed on standpipes. The utility hopes to undercut the market of the cartels, as residents prefer cheap water from a PPD rather than that from a cartel. With the market of the cartels undercut, less water is stolen from the network through illegal connections. At the same time, this reduction of non-revenue water allows the utility to sell more water in other locations of the city, where the ability and willingness to pay for water of consumers is relatively high and where the utility can charge cost-recovering tariffs.

As such, the introduction of pre-paid dispensers in the cases studied is noteworthy as the purposes for introducing the PPDs do not align with the commonly argued reasons for opting for PPDs. We highlight three main points of divergence:

1. The main motivation of water utilities to install PPDs does not directly reflect a motivation to increase cost-recovery rates in the location where the dispensers are installed. This is visible in the cases of Nairobi and Nakuru where utilities have chosen to charge prices for water consumed from these dispensers below cost-recovery rates (sometimes also referred as ‘social tariffs’). The fact that both Nairobi and Nakuru charge prices below cost-recovery highlights that the technology is not being used as ‘the ultimate cost-recovery tool’ (Berg and Mugisha, 2010:595). Furthermore, the utilities are actually purposefully making a loss by operating these dispensers.

2. Rather, the motivation of water utilities for installing PPDs is that it alters the relationship between end-consumers and intermediaries by removing the intermediary (i.e. kiosk operator, landlord and cartel).

3. The dispensers are generally installed in pre-existing connections or standpipes. PPDs were not installed for ‘new’ connections and therefore they have not contributed to expanding services, as it is often claimed.

To understand the reasons for introducing PPDs, it is important to take into account the broader context of the service delivery system in each particular situation. Most illustrative is perhaps the

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2. The official price charged at kiosks is 2 KES per 20 liters, whilst the price charged for PPDs is 1.5 KES per 20 liters.
city of Nairobi. Nairobi is currently characterized by growing water shortages and rationing of water supply. This means that an important goal of the water utility is to increase control over the existing water flows and reduce, as much as possible, water losses. PPDs were viewed as a technology that would enable these goals. By reducing illegal connections, the water utility would be able to control the flow and quantity of water in the city. The utility is willing to charge a symbolic price for consumers of the PDDs, knowing that the quantity of water they can consume through 20 liter jerry cans is limited in comparison with the amount lost through illegal connections and leakages. The water ‘saved’ in this way, can be delivered to consumers with in-house connections that are rationed due to the water shortages.

**Take Away Message**

The purpose of installing PPDs may not only be targeted to ensuring cost recovery when extending services. It can also be related to altering the water supply chain for existing connections by removing intermediaries such as kiosk operators, landlords or cartels.

**Technical Limitations**

In all three cities a large number of PPDs were no longer working at the moment this report was being drafted. In Nairobi 88 out of 170 PPDs (52%) were working, in Kisumu 22 out of 45 PPDs (49%) were operational, and in Nakuru only 30 of the approximately 265 PPDs (11%) were functioning during the field visit. The breakdown of the PPDs has a number of different explanations, related to the design specifications of the PPD itself, the way in which it is used, and the distribution network supplying the water to the PPDs. Most of the technical limitations reflect the gap between the original design and the very different conditions these dispensers must endure on the ground.

The main technical challenges and underlying reasons were as follows:

- Technical limitations of the PPDs led to utility staff complaints about breakdowns of the PPDs. These were mainly attributed to faulty valves and the rapid depletion of batteries. As a result, water utility operators improvised solutions using materials and resources that were locally available. Often these improvised fixes then lead to additional problems. For example, the tampering with or the use of alternative batteries led to the breakdown or failure of the PPDs’ displays.

- PPDs require a well-functioning water network (ie. sufficient flow and pressure) and do not compensate for poor network conditions. In Kisumu, Elster Kent meters were installed in locations where the network suffers from low water pressure. As a result, these dispensers, which have a tap that is relatively elevated, do not function or only function during certain hours of the day when water pressure is sufficient.
• PPDs break down when they are used for purposes beyond their design specifications. In Kisumu, KIWASCO opted to initially supply 2 tokens to kiosk operators to provide water through the PPDs\(^3\). This limits the amount of tokens to be purchased but it also means that any given token is used more frequently, often beyond the design specifications of an individual’s consumption pattern. As a result, tokens wear out quicker than anticipated and become inoperative. In Nakuru, the number of households that were to be served from one dispenser increased from an initial target of 15 to 50 households per PPD. The increase in usage implied that batteries ran out sooner, requiring more frequent replacement. These (special) batteries are expensive and not easy to procure. Overall, increased frequency of usage meant the PPDs require more and different maintenance than anticipated. This had a negative impact on the warranty claims that the utility could call upon. In the case of Kisumu, the supplier refused a warranty claim arguing that the warranty was no longer valid given the improper use of the PPDs.

• PPDs have been subject to theft and vandalism. Particularly in Nairobi examples of theft and vandalism led to the breakdown or malfunctioning of PPDs. Theft is particularly common for elements of the dispenser with relatively high re-sell values such as in the case of solar panels. Solar panels are used as energy source when PPDs are installed in remote areas (eg. Susteq dispensers). Vandalism occurred also when cartels felt that an installed PPDs threatened their market. NCWSC only installs PPDs were the installation can be protected. The people in charge of protecting the PPDs engaged a partnership with community-based organizations to operate the PPDs. These community-based organizations often have strong ties with the cartels, meaning that the use of the PPDs formalizes (eg. regulates) the role of these cartels rather than reducing their involvement in providing water services.

The breakdown of PPDs can have serious consequences for the continuation of service provision and the operations of the utility. In Nakuru, some of the PPDs stopped functioning due to difficulties of the utility to procure expensive new batteries. Consumers then opted to access the supply lines directly by cutting the pipe supplying the PPD. Once this supply line was ruptured, however, the water utility would have to fix both the supply line and the PPDs for these consumers to obtain water through the PPDs.

Apart from breakdowns, service provision through PPDs faces additional technical constraints. The PPD in Kisumu provided water through a pipe with a smaller diameter than that of the previous connection. By changing the connection in the kiosk from a post-payment meter to a pre-paid dispenser, the utility also altered the rate of flow at which water could be supplied to consumers. Kiosk operators who were serving a large customer base took longer to serve customers, leading to waiting times. Some kiosks where PPDs were installed even lost customers who opted for other (post-payment) kiosks where they would be served faster. In some cases the revenue generated by kiosk operators using PPDs declined by 60%-76%. These kiosk operators requested the old connection to be re-installed.

3. The idea of letting the kiosk operators operate the PPDs was a first step. In a second step the kiosk operators would be phased out and tokens would be given to consumers to operate the PPDs.
**Take Away Message**

It is important to view the PPDs, its usage, and the existing water system as an integrated system. The PPDs are part of a technical system (condition of the network, water pressure, water availability) and social system (kiosk operators, landlords, and cartels). It is vital to analyse how such a dispenser fits within the existing technical and social systems prior to its installation.

It is important to ensure that usage of the PPD adheres to its design specifications. Improper use can lead to breakdowns.

It is important to have a back-up for water supply. This will ensure that breakdowns of the PPDs do not immediately lead to consumers being cut-off (and, thus, needing to access water through illegal connections or becoming dependent on informal suppliers).

**The Hidden Costs of PPDs**

During interviews with staff of the water utilities, it was indicated that the introduction of the PPDs required a specific capacity to be developed within the utility to monitor and repair these dispensers. In all three cases the technical staff of the utility indicated that the PPDs required more maintenance than the post-paid meters and much more than initially planned. Moreover, as explained by a technician in Kisumu, the PPDs are not comparable to post-paid meters and their installation requires the utility to develop specific capacity to maintain and repair these dispensers. Also in Nairobi there is a specific group of technicians that deal only with PPDs. Time allocation for repair and maintenance and the requirement of specialized knowledge appears to have come as a surprise for most of utilities. They assumed that the PPDs would be installed and then function autonomously. This argument is often used by distributors in their selling or promotional pitches. For example, the utilities in Kisumu and Nakuru did not have initial budget allocation for the monitoring and maintenance of pre-paid dispensers. As a result of the lack of specific capacity and budget available for repairs, a relative large number of these dispensers broke down.

In addition, in cities like Kisumu, PPDs were installed scattered over the network and difficult to reach. This, in addition to the limited of staff who are skilled to deal with pre-paid dispensers results in considerable delays in repair time of these dispensers.

The large number of non-functioning PPDs also raises questions about the validity of the assumptions made and subsequent cost-benefit analyses done to inform the decision whether to install these dispensers. Is the additional capacity for repairing and maintaining these dispensers taken on board in this assessment? If so, to what extent? With only 52%, 49% and 11% of the dispensers functioning in the three cases, the question is how the costs of non-functioning dispensers are incorporated in this analysis?
**Take Away Message**

The installation of PPDs needs the capacity and resources for maintaining and repairing the dispensers. Not acknowledging these costs and accounting for it in the decision to install PPDs can lead to unrealistic expectations and plans, leading to a large number of PPDs becoming non-functional.

**PPDs and External Parties**

Most of the utilities found it difficult to engage with the producer of the PPDs concerning challenges and repairs of the PPDs, whilst at the same time being highly dependent on the PPD supplier. An employee from the IT department in Nakuru explained: “*When they bring the software, they will give you a lower version. If you call for help they say they no longer support that version*”4. The supplier then insists the water utility needs to purchase a software upgrade and license before they can address the problem. In the case of Nakuru, the water utility settled for a license for 1 year at 100,000 KES. In order to avoid issues with the software, NAWASSCO now operates the system offline5 and has not upgraded its software.

The challenging relationship with the PPD supplier due was reported for two reasons. The first relates to the monopoly that suppliers of dispensers have. In the case of Elster Kent PPDs, for example, Nairobi Ironmongers is the official supplier in Kenya. This means that any request concerning the PPDs has to go through Nairobi Ironmongers. The second reason is that in a number of cases, the PPDs were purchased by donors involved in the decision making or the definition of specifications for procurement. As a result, in some events an after-sale service was not included in the procurement.

In addition to suppliers, other external parties play an important role. In the Kenyan context, the role of donors is significant for a number of reasons. First, the regulator, WASREB6, has established a tariff policy that limits the ability of water utility to use self-generated revenue for investment in improvement or expansion of network. The tariff policy classifies water utilities according to their ability to operate on the basis of cost recovery and the three water utilities that were studied for this report all are in a category (class II) that does not allow them to invest revenue from tariffs in service extension. This means that these utilities need to acquire investment funds from either the WSTF7 or donors to fund service extensions. There is, thus, a considerable dependency on donors for funding investments. At the same time, these donors also have to adhere to targets they have to achieve.

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4. NAW4, Interview 2/5/2019
5. NAW4, Interview 2/5/2019
6. Water Services Regulatory Board
7. Water Sector Trust Fund
These targets are frequently linked to achievements in extending service coverage. As such, donors have an incentive to try to reach as many households as possible with a limited investment.

**Take Away Message**

In deciding to install PPDs, the water utility needs to have very clear agreements with the PPD supplier concerning warranty and after-sale service. It is important to plan for a periodical interaction between the water utility and the PPD supplier. This interaction concerns technical issues of repair, costs and accessibility of spare parts, as well as software updates and IT support.

Water supply involves more actors besides the water utility. Therefore it is important to harmonize the interests and aims of all actors in decisions about PPD technology and its usage. When interests of different actors are not aligned it may lead to the breakdown of the PPDs.

**Conclusions: Problems, but support for the PPDs remains**

In each of the cases, a discrepancy appeared to exist between the actual experiences of the pre-paid dispensers and how the technology was viewed by staff of the water utility. On the one hand, in all three cases only 52%, 49% and 11% of the PPDs are working. However, staff in the utility working with PPDs and were confronted with problems and breakdowns on a daily basis, repeated how, if it would work properly, it would be a very welcome technology. We identified some reasons for this rather dualist assessment of pre-paid dispensers:

- First of all, the promise of the tool remains persuasive. The idea that you would only have to “just sit and the money comes in” is tempting. Also the possibility of reducing dependencies on kiosk operators or the ability to defuse conflicts over water between landlords and residents remains appealing to utility staff.

- Second, the technology gives the utility the image of being an advanced, cutting-edge water utility. This image of being technologically advanced gives the utility a level of prestige within the community of water utilities.

- Third, the experience of staff of the water utility is that consumers tend to trust PPDs more than bills received from post-paid meters. The clear accounts for water usage provided by the PPDs was something appreciated by the consumers. The absence of visible human intervention

8. KIW3, Interview 29/4/2019
provides a sense of trust. For staff of the utilities this meant an improvement in their relations with the consumers.

**Take Away Message**

In thinking about PPDs there is frequently a confusion of the potential of PPDs and the actual experiences with PPDs. The potential benefits of PPDs are still appealing even if actual experiences are less successful.

PPDs can be presented as a cutting-edge technology that instils prestige in a water utility. Although unrelated to actual service provision of the water utility, such prestige does matter in the community of water utilities.

Perhaps the most important lesson is that the ‘success’ of the tool depends very much on how it is used, where it is used, and in what particular context it is used. Although incentives may exist to use the tool in a certain way (for example, to serve at least 50 households), the technical specifications of the dispenser may not allow for this. The quality of the existing water service network greatly determines where a PPD can potentially be used, and PPD technology cannot compensate for faults in the system. If the network cannot supply adequate amounts of water at the right pressure, PPDs become severely constrained. The PPDs intervene in existing relations between intermediaries and consumers. This was one of the reasons of installing this technology in the first place, but it is important to consider the consequences of these interventions. It may mean limited locations to install such PPDs or that when the intermediary supplies a lot of water, the specifications of the PPDs are not suitable.

What the cases also suggest is that the way knowledge and experiences in the water services sector are shared may not always lead to performance improvement. Emphasis is particularly given to developing and then presenting best-practices. These practices serve as a guiding example for other water utilities. There is value in sharing such positive experiences. However, it is also as important to share experiences of relevant failures. In the three Kenyan cases, the decision to engage with PPDs was partially based on information received from other water utilities. This information, was not always entirely accurate. If the challenges of installing and operating PPDs were more clearly presented, there could have been a different approach to the repeated challenges with PPDs in Nakuru, Kisumu, and Nairobi.
Annex: Case Studies Kisumu, Nakuru and Nairobi

Kisumu Water and Sewerage Company Limited

“The first 3 months were perfect. After that the problems came out...”

The water utility in the city Kisumu introduced pre-paid dispensers at two moments. The first phase concerned the introduction of TAGG meters in 2008/2010, which were piloted when the utility rolled out the Delegate Management Model in Kisumu. The introduction of the TAGG meters was not a success. The meters did not work due to problems with the software and this lead to a large number of customer complaints. The meters were subsequently changed for post-paid meters.

The second phase consisted of the introduction of 45 Elster Kent pre-paid meters in 2016. The introduction of the pre-paid dispensers was initiated by the pro-poor coordinator of KIWASCO who submitted a proposal for 45 meters under the PEWAK Project. The motivation for selecting pre-paid dispensers came from experiences presented by other utilities that had piloted pre-paid dispensers. These utilities presented the pre-paid dispensers as best-practices and highlighted the benefits of this technology. Of particular importance were the stories of the National Water and Sewerage Corporation in Uganda and the Nakuru Water and Sanitation Service Company (NAWASSCO). Particularly the “stories of Nakuru fell sweet”.

Pre-Paid Dispenser Approach in Kisumu

During the installation of the pre-paid dispensers in Kisumu, the utility targeted kiosk operators in various places scattered around the city. According to an internal KIWASCO evaluation “[s]ome of the best performing kiosks were identified for pilot with the PPDs” (KIWASCO, 2018). The tokens to operate the pre-paid dispenser were not given to consumers being served by the dispenser, but rather were given to the kiosk attendant. Each kiosk received two tokens to operate the PPD. One of the considerations in limiting the amount of tokens distributed revolved around the cost of the tokens. Each token cost KIWASCO 2,500 KES.

The targeting of kiosk operators was part of a strategy to phase out these kiosk operators. By first placing the pre-paid dispensers with kiosk operators, consumers would get used to the use of pre-paid dispensers. In this first phase the kiosk attendants would control the token and act as an intermediary between KIWASCO and the end-user. In the second phase a wider distribution of tokens would take place. End-users would receive their own token allowing the intermediaries...

9. KIW4, Interview 29/4/2019
10. Performance Enhancement of Water utilities in Kenya through benchmarking, collective learning and innovative financing (PEWAK). The aim of the PEWAK project is to improve performance of water utilities in Kenya through benchmarking and peer-peer learning, the implementation of NRW reduction plans and through improved service delivery to the urban poor (https://www.vei.nl/projects/partnership-for-performance-enhancement-of-water-utilities).
11. KIW2 Interview 29/4/2019
The kiosk owners (the kiosk owners) to be phased out\textsuperscript{12}. The reasons for wanting to phase out the kiosk owners and attendants is that it would both improve water access of consumers reduce exploitation by the kiosk operators (KIWASO, 2018). Kiosk operators close their kiosk when they have engagements elsewhere. During this time, consumers have to visit other kiosks farther away for accessing water. At times kiosks remained closed for stretches of two or three days, meaning that during this time consumers had no access to water from this kiosk. The introduction of pre-paid dispensers that could be accessed by consumers would then allow for improved access to water and also reduce the price for a jerrycan of 20 liters from 1.5 KES (charged by the kiosk operators) to 1 KES per 20 liters. Also the direct access of consumers would reduce the possibility of exploitation by kiosk operators who, when scarcity exists, have been known to charge more than the official price of 1.5 KES per 20 liters.

The kiosk operators that received a PPD are charged a fixed amount of 520 KES for the first 10 m\textsuperscript{3} of water they consume. This amount consists of a fixed charge of 400 KES for water, meter rent (70 KES) and regulatory fee (50 KES). The amount of 520 KES is billed to the kiosk operators even if the actual consumption at that kiosk is below 10 m\textsuperscript{3}. Every additional cubic meter (beyond 10 m\textsuperscript{3}) that the kiosk operator uses is priced at 35 KES. The kiosk operator is billed on the basis of the reading of the meter, which is part of the PPD.

Pre-payment is done by uploading credit on the token. Each token has a maximum credit of 1,500 KES. The tokens can be uploaded at the KIWASCO Head Office or through two mobile units. Charging of two mobile units is done at the Head Office and each mobile unit can be charged up to 200,000 KES. By inserting the token into the PPD, an amount of 1 KES is deducted from the token credit for every 20 liters of water withdrawn (50 KES per m\textsuperscript{3}).

The Elster Kent consists of a meter with pulse output, is powered by a small 4.5V lithium battery and consists of an electronic module and a latching valve. Water is supplied to the PPD through 0.5 inch pipe.

\textsuperscript{12} KIW1 Interview 29/4/2019
The Elster Kent PPDs installed by KIWASCO face a number of challenges. As a result of these challenges currently only 22 out of 45 PPDs are functional. The challenges faced in Kisumu are as follows:

1. Wear and tear of the small valve diaphragm. The Elster Kent PPD contains two valves. In Kisumu the small valve quickly malfunctioned as the rubber valve diaphragm wears due to frequent vibrations (KIWASCO, 2018) after about 6 months after installation. The malfunctioning of the valve leads to free flows of water. KIWASCO has decided to replace this valve with a different valve (from a different supplier).

2. The life time of the battery is limited. A battery normally should last 2-4 years. However, in Kisumu the first batteries already need to be replaced after 4 months due to the frequency

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13. KIW3, Interview 29/4/2019
of use of the PPDs. Most batteries had to be replaced after 8 months\textsuperscript{15}. Within 2 years of installation the batteries of all PPDs were replaced. The batteries used for the Elster Kent are unique and have a voltage of 4.5 V, meaning they are only available from the supplier (through Nairobi Ironmongers, which is the agent of Elster Kent in Kenya). The cost of these batteries is approximately 6,300 KES\textsuperscript{16}.

3. Wear and tear of tokens. As each PPD installed at a kiosk only has two tokens the frequency of use of these tokens is high. As a result of this frequency of use, the tokens get damaged and need to be replaced. As each token costs 2,500 KES, the replacement costs are considerable.

4. Intermittent supply due to lack of pressure. The Elster Kent is placed at an altitude which makes it easy for the kiosk operator to insert the token and to allow for the jerrycan to be placed on a concrete slab (see figure X). This promotes cleanliness as the jerrycan is not positioned on the ground, but also requires a certain pressure for the PPD to operate. In Kisumu various PPDs either do not function at all due to the low pressure or function only part of the time (mainly at night) when the pressure in the system is sufficient.

Although some of the technical challenges with the Elster Kent in Kisumu are linked to the meter itself (issues with the valve) other challenges appear to be the result of how the meter is being used and where it has been installed. By placing the PPDs at kiosks and only providing 2 tokens for each kiosk operator, the PPDs and tokens are subject to a frequency of use that is much higher than if the PPD would have been installed in single household or small community, in which each user would have their own token. Also the issues relating to pressure, appear to be more challenges caused by the characteristics of the network rather than the PPD itself.

\textsuperscript{15} KIW3, Interview 29/4/2019
\textsuperscript{16} Interview NAW1, Interview 2/5/2019
Challenges of Billing and Payment

One of the challenges of the PPD systems is that a discrepancy can occur between the amount billed and the amount paid. These challenges take on a number of forms:

1. The discrepancy between what is billed and what is paid. KIWASCO bills the kiosk operator 520 KES for the first 10 cubic meters regardless the amount used. If the kiosk operator only uses 4 cubic meters, it will be billed for 520 KES. However, the pre-payment has only been done for the 4 cubic meters, which amount to only 200 KES. What results is that the kiosk starts to build arrears as the amount billed exceeds the amount pre-paid.

2. Meter and dispensing errors. KIWASCO bills the kiosk operator on the basis of the meter reading. If errors occur, such as the meter running without dispensing water or water being dispensed without credit being deducted from the token a discrepancy occur between what is billed and what is paid. The challenges with the valves described earlier have led to a free flow of water, which in some instances lasted throughout the night and day before being addressed (KIWASCO, 2018). Such free flows constitute non-revenue water.

3. KIWASCO also experienced challenges related to consumers trying to fraud the system by using a single payment multiple times. After having paid through M-PESA, the customer would come to the KIWASCO office to upload credit on the token showing the payment receipt on
their phone. Sometime later, they would use the same message to again upload credit on a
token. KIWASCO had to adjust the procedure for uploading credit on tokens to mitigate this
issue.

**User Challenges**

The decision to install the PPDs at kiosks also brought challenges for the kiosk operators that initially
used the PPD to dispense water to the consumers of the kiosk.

1. The flow of water is too low. KIWASCO initially installed the PPDs with kiosks that were
considered “some of the best performing” (KIWASCO, 2018). However, the diameter of
the pipe and the pressure at which water was supplied to the kiosk was insufficient for the
commercial purposes of the kiosk. Because of the low flow of water, potential customers faced
considerable waiting times. As a result, consumers would opt to go to a different kiosk (with
a post-paid meter) which was able to supply water quicker rather than wait to be tended to at
the PPD kiosk.

![Figure 3: A water vendor fills his containers at a kiosk. In order to tend to these customers quickly the kiosk requires a certain flow of water.](image-url)

17. KIW4, Interview 30/4/2019
The low flow of water also impacted revenue collection for KIWASCO. Whereas some of the better performing kiosks had considerable sales with the post-paid meter, the amount of water sold with the PPD dropped significantly. Table 1 provides an overview of how the introduction of PPDs impacted sales at 10 water kiosks. The lower sales both impact the kiosk operator and KIWASCO, which experiences a decline in revenue.

Table 1: Changes in Sales to Water Kiosks with Post-Paid Meters and Pre-Paid Dispensers

<table>
<thead>
<tr>
<th>Kiosk</th>
<th>Billing Post-Paid Meter (Jan-Feb) in KES</th>
<th>Billing Pre-Paid Dispenser (Aug-Sept) in KES</th>
<th>% decline in Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kiosk 1</td>
<td>26,286</td>
<td>15,257</td>
<td>42</td>
</tr>
<tr>
<td>Kiosk 2</td>
<td>29,468</td>
<td>15,187</td>
<td>48</td>
</tr>
<tr>
<td>Kiosk 3</td>
<td>18,969</td>
<td>4,511</td>
<td>76</td>
</tr>
<tr>
<td>Kiosk 4</td>
<td>47,881</td>
<td>24,201</td>
<td>49</td>
</tr>
<tr>
<td>Kiosk 5</td>
<td>19,500</td>
<td>18,893</td>
<td>3</td>
</tr>
<tr>
<td>Kiosk 6</td>
<td>45,270</td>
<td>18,086</td>
<td>60</td>
</tr>
<tr>
<td>Kiosk 7</td>
<td>17,414</td>
<td>10,521</td>
<td>40</td>
</tr>
<tr>
<td>Kiosk 8</td>
<td>15,222</td>
<td>7,551</td>
<td>50</td>
</tr>
<tr>
<td>Kiosk 9</td>
<td>44,280</td>
<td>21,480</td>
<td>51</td>
</tr>
<tr>
<td>Kiosk 10</td>
<td>26,216</td>
<td>20,666</td>
<td>21</td>
</tr>
</tbody>
</table>

Source: KIWASCO, 2018

2. The maximum credit on the token is too low. The installation of the PPDs targeted some of the best performing kiosks, which sell a considerable amount of water. At the same time the token that they received had a maximum credit of 1,500 KES. This meant that some of the kiosk operators had to visit the KIWASCO Head Office twice a day to upload credit on their token. Particularly in the weekends, when the Head Office is closed, this lead to problems as the kiosk operators were not able to upload credit on their tokens.

According to staff of KIWASCO there was a difference in how the consumers evaluated the PPD, depending on the customer being someone that already operated a kiosk and had experienced the post-paid meters or if the kiosk operator was a ‘new’ customer that started operation with the PPD.

18. KIW1, Interview 29/4/2019
The customers who had worked with the post-paid meters were much more critical of the PPD than customers who did not have experience with the post-paid meters\textsuperscript{19}.

Also the customers that complained about the low pressure and the limited credit amount for the tokens, in principle, did not outright reject the idea of PPDs. If the PPD would allow for sufficient pressure and allow for a higher credit maximum, they would welcome the PPD. The main advantage they saw in the use of PPDs is that it clearly accounts for the usage of water\textsuperscript{20}. Particularly kiosk operators that employed kiosk attends for the actual operation of the kiosk, saw of the benefits of this.

**Maintenance Challenges**

In addition to the technical challenges described above, the PPDs also face some maintenance challenges. The main maintenance challenges are as follows:

1. Frequency of maintenance. Whereas the post-paid meters are tended to once a month, this is more frequent for the PPDs. Although the frequency of maintenance is variable, depending on the specific meter, it was estimated that the PPD required about two maintenance visits per month and in some cases three times a month. The frequency of maintenance is particularly a result of the strainer in the PPD, which is blocked by debris and needs to be cleaned (KIWASCO, 2018).

2. Spare parts had to be bought from the supplier that also supplied the meters. The producer of the Elster Kent is a South African company, which operates in Kenya through an agent, Nairobi Iron Mongers Ltd. Nairobi Ironmongers Ltd. Is the only company that sells the spare parts for the PPD. As such, the company has a monopoly on spare parts, which are not available locally in Kisumu.

3. The PPDs were bought by a donor, based on a project proposal that KIWASCO submitted. In this process, no service agreement was established to support KIWASCO to keep the PPDs operational. Nairobi Ironmongers Ltd. Simply delivered the PPDs and from that moment on it was KIWASCO that was responsible for maintaining the PPDs. Although on paper there was a 2-year warranty, the supplier claimed that warranty was not applicable due to the high frequency of use of the PPD.

   The lack of after sales support for KIWASCO meant that they had to learn about repair and maintenance of the PPD on the job. Although this presented a challenge to the technicians they also saw it as an opportunity to learn about the PPD as the PPDs are “totally different” from the post-paid meters\textsuperscript{21}.

4. In two cases the LCD screens needed to be replaced. Some of the LCDs are discolouring, which is leading to lower visibility of the screen.

\textsuperscript{19} KIW1, KIW2, Interviews 29/4/2019  
\textsuperscript{20} KCU2, KCU3, KCU4, Interviews 30/4/2019  
\textsuperscript{21} KIW3, Interview 29/4/2019
It was highlighted that there had not been any difficulties with meter inside the PPD. The technicians of KIWASCO largely left the meter untouched.

**IT Challenges**

The IT-related challenges of the PDDs are as follows:

1. One of the main IT challenges in Kisumu appear to relate to the uploading of the tokens. This cannot be done remotely and needs to be done in the KIWASCO Office. Customers complain about the fact that the office is only open from Monday to Friday.

2. KIWASCO itself cannot change anything about the software of the PDD. They need the supplier for this.

3. KIWASCO installed one version of the software and have not upgraded the software. They do not connect the system to the internet as this would make the system vulnerable for viruses.

4. KIWASCO currently works with two books that are not integrated. One book is for the accounts of the customer using the PPD. The second book are the accounts of consumers using post-paid meters.

**Reflection**

- Despite the challenges and the low number of PPDs that are actually operational, within the water utility, there is considerable support for the concept of PPDs. It is viewed as a technology that can be beneficial for the water utility whilst also addressing the interests of the consumer by reducing exploitation by kiosk operators and improving access to services. As one of the staff of KIWASCO explained: “I would just sit and the money comes”.
- Also, if it functions, the technology is seen as reducing NRW, which is important for KIWASCO.

- At the same time, the experience means that it is unlikely that KIWASCO itself will invest in PPDs. According to one staff member: “No utility is interested to invest in pre-paid meters.” However, if a donor comes that wants to support them and repair and install the PPDs, they would be willing to support that. KIWASCO also thinks that the technology is evolving and improving. You need to stay in touch with the developments of this technology. If there is a functional PPD system, they would be interested in using it as they still see the benefits of such a system.

- The choice for KIWASCO to pilot the PPDs is based on the success stories of Nakuru and NWSC in Uganda. This is interesting as NAWASSCO faces similar challenges as KIWASCO with respect to the PPDs (and these challenges already started in 2014). The pro-poor coordinator of KIWASCO

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22. KIW3, Interview 29/4/2019
23. KIW1, Interview 29/4/2019
24. KIW3, Interview 29/4/2019
25. The unwillingness to invest in pre-paid dispensers was also referred to by other resource persons (MM1, Interview 6/5/2019)
26. KIW2, Interview 29/4/2019
argued that “no one tells failure stories”. It is hard to get information about the actual functioning of PPDs. Everyone wants to show their success. This means that in Kisumu similar challenges (valves, batteries) had to be addressed as in Nakuru, even though the first problems with batteries and valves appeared in Nakuru in 2014.

- The PPD is as good as the network. Network failures also mean PPD failures. If the network is characterized by intermittent supplies and rationing than this will also impact the PPD. The ideal of 24/7 access through a PPD thus requires a well-functioning network.

![Figure 4: The PPD on the left is not function as the line feeding the PPD was cut during a road construction (picture on the right).](image)

- Consumers tend to trust PPDs. If they have a bill of 9,000 KES they will pay it if is a PPD. But if they have a 3,500 KES bill from a post-paid meter they will complain. The technology instils confidence. It is also a message to the kiosk operator not to con the water utility.

- The PPD gave KIWASCO a positive image (technologically advanced)...only a few water utilities in Kenya are using PPDs.

- The fact that the water utilities do not purchase the PPDs themselves, but that this is done through donors complicates matters with respect to the post-purchase service. There is only a limited warranty. The agent of the supplier has a monopoly on the spare parts and the agent of the supplier is essentially a “marketing-man” who does not have any technical knowledge of the system. This complicates repairs when the PPD breaks down. KIWASCO has developed considerable knowledge on the PPDs, but they could still benefit from more assistance.

27. KIW3, Interview 29/4/2109
28. KIW2, Interview 29/4/2019
Nakuru Water and Sanitation Service Company

“When it is working, it is very good…”

The Nakuru Water and Sanitation Service Company piloted a first batch of PPDs (Elster Kent) in 2012. This first batch of 15 dispensers was funded through the Water Services Trust Fund (WSTF). A second batch of about 85 Elster Kent dispensers, funded by USAID through a SUWASA project, was installed in 2013. A third batch of approximately 85 Elster Kent dispensers was funded by WSUP and installed in 2014. A fourth batch of 30 Tagg PPDs was financed under a project with Vitens Evides International. An additional 50 Tagg meters were funded by the WTSF in 2016. These Tagg meters were installed in 2016. Of the approximately 185 Elster Kent PPDs, currently only 30 are working. Of the 80 Tagg meters, none are working. In fact, the Tagg meters only functioned for 1 day before breaking down. As such, of the approximately 265 PPDs in Nakuru only 30 are currently functional.

<table>
<thead>
<tr>
<th>Year</th>
<th>Quantity</th>
<th>Type of Meter</th>
<th>Donor</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>15</td>
<td>Elster Kent</td>
<td>Water Services Trust Fund</td>
<td>Included network extension</td>
</tr>
<tr>
<td>2013</td>
<td>85</td>
<td>Elster Kent</td>
<td>USAID (SUWASA)</td>
<td>Only pre-paid meters (no network extension)</td>
</tr>
<tr>
<td>2014</td>
<td>85</td>
<td>Elster Kent</td>
<td>WSUP</td>
<td>Included network extension</td>
</tr>
<tr>
<td>2016</td>
<td>30</td>
<td>Tagg</td>
<td>Vitens Evides International</td>
<td>All meters are non-functional</td>
</tr>
<tr>
<td>2016</td>
<td>50</td>
<td>Tagg</td>
<td>Water Services Trust Fund</td>
<td>All meters are non-functional</td>
</tr>
</tbody>
</table>

Pre-Paid Dispenser Approach in Nakuru

The pre-paid dispenser approach taken by NAWASSCO is strongly influenced by the nature of the low-income areas in Nakuru and the issues of water control and payment in these areas. What characterizes the low-income areas in Nakuru is that many people living in these settlements live on gated plots with 20-40 houses that are rented by landlords. Often the landlord has a connection. The landlord is billed for the water consumed. At the same time the landlord transfers the bill to individual households by adding an amount to the rent charged for the rent of the house.

29. The selection for the Tagg meters was based on advice from Vitens Evides International, which considered the Tagg meters to be of better quality. Although NAWASSCO staff explained that according to them the Tagg meters did have better batteries, the main problem was with the software. Also the aluminium casing of the Tagg meters was not considered suitable for the low-income areas of Nakuru as the meters may be vandalised to obtain the aluminium casing (NAW1, Interview 2/5/2019).
The payment of water by tenants leads to a number of problems for these consumers. First of all, the landlord may charge considerably more for water than the water bill served by NAWASSCO. The landlord thus creates a profit on the sale of water to tenants. Examples exist of landlords charging excessive amounts for access to water. A second problem concerned the desire of the landlord to control access to water by consumers. Rather than allow for free access the landlord would lock the tap in order to ensure that tenants would not consume too much water (leading to a high water bill for the landlord). At the same time, the landlords found the collection of payment from tenants and the need to control access to water a troublesome endeavour. In this context the pre-paid dispenser was thought to be a useful instrument. It would allow the tenant to freely access water at any time. Also payment for water would be fixed at 1.5 KES, which is below the official pro-poor tariff of 2 KES per 20 litres. Moreover if it was placed inside the gated plot, it would safeguard the pre-paid dispenser from vandalism. At the same time the landlord would be freed from the collection of payment for water and the need to control access to water in order to avoid overconsumption.

There is also a financial gain to be made by NAWASSCO by providing water services through pre-paid meters. NAWASSCO delivers water to kiosk operators at 0.75 KES per 20 liters, which is then sold to consumers for 1.5 KES (assuming the kiosk operators are not overcharging). If consumers buy water from pre-paid dispensers, they would still pay 1.5 KES per 20 liters. However, this money would all be accrued by NAWASSCO. As such, the PPD allows NAWASSCO to sell water at twice the price that it receives for selling water to the kiosk operators.

Every household is provided a token. The tokens have a cost of 1,700 KES (initially 1,200 KES), but households pay a deposit of 300 KES to obtain a token. If the household needs to replace the token because it is broken or lost they need to pay the full price of replacing the token.
Figure 5: A gated plot in a low-income area in Nakuru served by a pre-paid dispenser.

Figure 6: A landlord posts a notice about the house rent, which includes payment for water.
The initial decision to opt for the instalment of pre-paid dispensers was influenced by meetings organized by WASPA in which pre-paid dispensers were presented as being very successful. With funding from the Water Services Trust Fund, 15 Elster Kent meters were installed in compounds housing 6-10 households. Each household had their own token to operate the PPD. The experiences of these 15 PPDs was overwhelmingly positive. Given this experience opted for a second batch of PPDs financed by USAID in 2013. Whereas the first batch of meters served a relatively small community of 6-10 households, the second batch of meters was to serve a larger group of consumers. These PPDs had to serve between 40-50 households. With the more frequent use of the PPD, problems quickly appeared. The third batch of PPDs, supplied by WSUP, had similar problems as the second batch.

**Technical challenges**

The main technical challenges experienced in Nakuru related to the valves and batteries.

- Similar to the case of Kisumu the small valve of the Elster Kent malfunctioned because of the wear and tear of frequent use. This would lead to either a free flow of water or closing of PPD, meaning it would not dispense any water. To address this issue technicians of NAWASSCO resorted to adding a very thin membrane to the valve to cover the hole.
The batteries, which were supposed to have a life time of about 4-5 years, had to be replaced within a year. The battery used by the Elster Kent is a 4.5V battery, which is not locally available. Initially, the cost for a replacement battery was 2,500 KES. However, the price for the battery quickly went up to 5,000 KES. Currently the cost of replacing a battery from the official supplier is 6,300 KES. As this cost of replacement was deemed too high, NAWASSCO opted for installing locally available batteries, which they purchase at a price of 500 KES. These batteries, however were 6V batteries instead of 4.5V batteries. The 6V batteries can be recharged at a cost of 50 KES.

Because of the use of 6V batteries, many of the LCDs of the PPDs broke. NAWASSCO does not have the capacity to repair the LCDs and thus is dependent on the supplier for repair. However, the cost for repairing one LCD is approximately 28,000 KES. NAWASSCO does not have the budget to pay for this repair and, as a result, many of the PPDs are currently non-functional. The batteries of those PPDs that are still functional are not fully recharged when recharged as this would damage the LCD.

User Challenges

For users the main challenge relates to the non-functioning of the pre-paid dispensers. Whereas with a malfunctioning post-paid meters, the connection still allows consumers to access water, a malfunctioning pre-paid meter essentially cuts off supply. In the case of Nakuru, where less than 15% of the PPDs function this has meant that landlords/consumers either had to resort back to post-paid meters or in some cases the tenants cut the line feeding the PPD in order to access water.

In some cases consumers have experienced situations where, because the passed “a magnetic device” the token was affected. Any issue related to a malfunctioning of the token requires the consumer to pass by the NAWASSCO Head Office.

![Figure 8: A line feeding a PPD is cut in order to access water.](image)

30. NAK1, Interview 2/5/2019
**IT and Maintenance Challenges**

One of the main challenges that NAWASSCO experienced related to support from suppliers. For the problems facing the Tagg meters, the supplier visited a few times. However, according to staff of NAWASSCO, the person who came to repair the Tagg meters “said he had to go back and never came back again”\(^{31}\).

As highlighted above, the problems with the LCD are such that repair is not affordable for NAWASSCO. In this context it is also relevant to highlight that there were no separate budget allocations for repair or maintenance for the PPDs. As such, no budget was available for the repair costs of the LCDs (estimated at 28,000 KES per screen)\(^{32}\).

A major problem according to the IT staff of NAWASSCO relates to the suitability of the PPD for the infrastructure that NAWASSCO has. This not only relates to the physical distribution system but also the internet and power infrastructure.

Another challenge in the maintenance of the PPDs related to the software. “When they bring the software, they will give you a lower version. If you call for help they say they no longer support that version”\(^{33}\). The supplier then mentions that first the company needed to purchase a software upgrade and license before they could address the problem. The licence for the newer version of the software was offered at a cost of 500,000 KES for a period of 5 years. After negotiation NAWASSCO settled for a license for 1 year at 100,000 KES. In order to avoid issues with the software, NAWASSCO operates the system offline\(^{34}\) and has not upgraded its software.

Repair and maintenance of the hand-held credit uploading unit is a problem. “If you want them to repair the mobile unit, they give you a different version that does not match with the rest of the system”\(^{35}\).

In pursuing repairs with the help of the supplier there is a frustration that NAWASSCO is not able to contact the supplier (Elster Kent) directly. Instead everything needs to be arranged through their agent (Nairobi ironmongers), which has a monopoly on spareparts, software and services related to the Elster Kent. NAWASSCO even proposed to Elster Kent to send a team to South Africa to learn from the supplier, but the company refused.

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31. NAW2, Interview 2/5/2019
32. NAW4, Interview 2/5/2019
33. NAW4, Interview 2/5/2019
34. NAW4, Interview 2/5/2019
35. NAW4, Interview 2/5/2019

Experiences with Pre-Paid Dispensers: Lessons from Three Kenyan Cities
Reflection

- Despite that less than 15% of the pre-paid dispensers are working in Nakuru, the staff of NAWASSCO still thinks positively of the pre-paid dispensers. They argue that it allows for significant NRW reduction and very high collection efficiency. Also they highlight that there is a real demand for the PPDs. Both tenants and landlords appear to have approached NAWASSCO with the request to install PPDs. Moreover, NAWASSCO staff argue that if the PPDs work they can reach a break-even point after 3.5 years, which they find acceptable.

- NAWASSCO also sees a benefit in the PPD as it essentially does away with “fraud cases” by meter readers.

- Part of the challenges related to the supplier also appear linked to how the PPDs are financed. “When the donor comes he gives you everything. But after 6 months, you need people. But then there is no support”. This has meant that NAWASSCO has faced challenges in dealing with the suppliers, who essentially hold a monopoly on the (spare parts of the) pre-paid dispensers.

- NAWASSCO staff highlight the need for the PPD to fit the existing (physical, internet and power) infrastructure. For the system to work there needs to be a proper connection between the token, the hand-held and the dispenser. All need to be supported and functioning. None of these three can fail as they are all connected.

- NAWASSCO staff also indicate that in terms of maintenance and monitoring pre-paid dispensers require more attention and effort than post-paid meters.

36. NAW4, Interview 2/5/2019
Nairobi City Water and Sewerage Company

Nairobi City Water and Sewerage Company has a total of 170 pre-paid dispensers installed in the network. These concern 102 SUSTEQ dispensers\(^\text{37}\), 64 Elster Kent dispensers and 4 Grundfos dispensers. Of these dispensers currently 88 are functioning (72 SUSTEQ, 15 Elster Kent and 1 Grundfos). While the Estar Kent dispensers run on alkaline batteries, the Grundfos dispensers run on electricity and the SUSTEQ dispensers run on solar power.

Pre-Paid Dispenser Approach in Nairobi

The approach of using PPDs by the NCWSC is characterized by its focus on reducing water losses in low-income areas. The idea is that by providing safe water through pre-paid dispensers at a very low cost (0.50 KES per 20 liters), consumers will abstain from making illegal connections and will not have to buy water from the cartels. “If they get water, they will not damage other pipes”\(^{38}\). As such, the NCWSC explicitly does not view pre-paid dispensers as an instrument for providing water services on the basis of cost-recovery. The water utility understands and accepts that water provided through PPDs at a tariff of 0.50 KES per 20 liters cannot be delivered on the basis of cost-recovery. The reduction of water losses then allows the NCWSC to increase water sales in other areas of Nairobi. The revenue generated from these sales can then compensate the low tariff charged to consumers of the PPDs.

In low-income areas, water is frequently provided (illegally) through water cartels. These cartels often charge tariffs ranging from 5 KES to 10 KES per 20 liters. For these cartels the installation of PPDs forms a significant threat to their business. Given the high chances of the PPDs being vandalised by the cartels, NCWSC is increasingly opting to have the PPDs ‘mounted’ in the wall of a building. In addition to the dispenser being mounted into the wall of a building, the NCWSC also engages a community-based organization to manage the dispenser. As ‘manager’ of the dispenser a CBO is allowed to keep 40% of the revenue generated through the PPD. Under this construction NCWSC only generates 0.30 KES per 20 liters of revenue.

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37. According to the supplier of the SUSTEQ dispenser, the company had supplied a total of 269 dispensers to NCWSC (MM1, Interview 6/5/2019). Given that NCSWC mentions only 102 dispensers, it suggests that a large number (167) are currently stored to be installed at a later date. The 269 dispensers are part of a larger package of 800 SUSTEQ dispensers that NCWSC was going to install. However, due to issues concerning payment of the dispensers, the supplier and NCWSC are currently in arbitration.

38. NCW1, Interview 6/5/2019
28 Experiences with Pre-Paid Dispensers: Lessons from Three Kenyan Cities

39. NCW2, Interview 6/5/2019

Figure 9: a) Picture left: a SUSTEQ dispensers b) a SUSTEQ dispenser mounted in the wall of a CBO and c) a vandalised stand-alone SUSTEQ meter in one of the low-income areas of Nairobi.

Technical challenges

The technical challenges of the Elster Kent have been similar to the challenges in Nakuru and Kisumu. Problems occurred with the batteries, which were supposed to have a life-span of four years, but in most cases needed to be changed within a year\textsuperscript{39}. Also valves within the dispenser needed to be changed.

Whereas only 23% of the Elster Kent dispensers are functioning, currently a little over 70% of the SUSTEQ dispensers are functioning. According to staff of the NCWSC the SUSTEQ dispenser is technically a better dispenser. Of the 30 non-functioning dispensers 10 have been vandalised by cartels. The other 20 suffer from a range of technical issues relating to “inner components”, such as the flow meter, the solar system, the strainer and software.

Maintenance Challenges

Just as NAWASSCO, challenges related to the Elstar Kent and Grundfos PPDs at NCWSC were related to support from suppliers. The PPDs were supplied with no or limited after sales service warranty or repair contract with suppliers. With parts not readily available on the local market, staff had to improvise or go for alternatives in the event of breakdown of (parts)PPDs. For instance, staff had on many occasions replaced the electromagnetic valve of the Elstar Kent PPDs, which breaks down frequently with parts from the SUSTEQ PPDs, because these components are not available on the market. Also, the 4.5 volts alkaline batteries of the Elstar Kent PPDs are replaced with 1.5 volts dry cell batteries which are available on the market. Due to the low voltage of these dry cell batteries, they run out quickly and have to be replaced every two months.

As for the SUSTEQ PPDs, a contract was signed with after sales service warranty, so the supplier comes in to assist with repairs or provide the parts should the need arises.

\textsuperscript{39} NCW2, Interview 6/5/2019
Meanwhile, in contrast to the post-paid meters, the electronic make-up of the PPDs required that, they are monitored frequently. As such a nine member team has been constituted to carry out this frequent monitoring and maintenance.

**User Challenges**

Similar to the cases of NAWASSCO and KIWASCO, the main challenge for users relates to the non-functioning of the pre-paid dispensers. Power disruptions to the PPDs; due to the running out of the batteries of the Elstar Kent dispenser, or the lack of electric power supply to the Grundfos dispensers, and the malfunctioning or vandalism of the solar panels of the SUSTEQ dispensers, result in the cut off of supply to water points. When this happens residents have to rely on other sources, usually sources controlled by the cartels where water prices are on the high side.

Also in communities where the PPDs are not managed by CBOs, consumers rely on vendors from the NCWSC to recharge their tokens. These vendors go to such communities on specific days, therefore when consumers run out of credit/money on their tokens, they are not able to access water from the PPDs.

Further in some cases specifically with the Estar Kent PPDs, consumers have experienced situations where, the token malfunctioned (mainly due to frequent use), requiring them to purchase new ones.

**Reflection**

- In spite of the fact that over 48% of the PPDs installed are not operational, NCWSC is still willing to invest in more PPDs. For managers of NCWSC, the fact that they are able to control and sell water at very low prices to residents in the LIAs with the PPDs goes a long way in protecting infrastructure conveying water to those areas as well as to other parts of the city. Officials argue that, when consumers are able to access water at affordable rates, they control water cartels who would want to vandalise infrastructure and disrupt supply so they can sell their water at higher prices.

- For managers of NCWSC, their interest is not in recovering the cost of operations in the LIAs but as explained by an official at the informal region “to mainly control or protect the supply to areas where people need and can pay for more water.”

- Their acceptance of the PPDs as an appropriate technology for water supply in the LIAs is manifested in (the PPDs) in the company’s strategic plan for improvement of access in Nairobi city and the purchase of extra 800 PPDs (which are currently in their stores) for installations in various parts of the city.

- NCWSC has come to accept the SUSTEQ PPDs to be a better/preferred option to the other brands. Mainly due to the robustness of the equipment, the ease in accessing spare parts from the agent who has an office in Nairobi and the ease in usage of the equipment by the consumers.

40. NCW2, Interview 6/5/2019
• Due to vandalism, often by water cartels who see water supplied from the PPDs as a threat to their business, placement/mounting of the dispensers is limited to areas where the utility is sure of their protection. This situation as explained by a member staff of NCWSC has stalled the installation/mounting of the 800 PPDs currently in the stores of the utility.